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ON THE COVER

ENGINEERS of the Truck & Coach Division of General Motors Corporation have devised several special setups for testing various components of the vehicles produced. Whenever a change of any part is contemplated, or a supplier is trying to have a different one approved, a test is arranged to compare the merits of the two units: the one being used and the one being considered.

Springs are tested by means of the equipment pictured on our cover. A 12-inch air cylinder is arranged in a vertical position so that its reciprocating piston flexes both springs simultaneously. The cylinder can exert a direct push of 11,300 pounds with 100 psi air pressure. In this case an even greater thrust is wanted, so a lever is employed to produce it. The relentless, untiring piston moves up and down, flexing the springs over and over until one set fails. Two mufflers at the right of the cylinder silence the exhausting air.

•

THOSE BILLIARD BALLS

SOME of our readers doubted the statement in our January issue (page 12) that two billiard balls coming together in midair at equal velocities will not rebound. For instance, John H. Miller, vice-president of Weston Electrical Instrument Corporation, Newark, N.J., wrote:

"Compressed Air Magazine is always interesting to read. But the article . . . which makes reference to billiard balls that do not bounce is a high spot of some kind. If ivory billiard balls were not elastic and did not rebound with almost their total energy, one might as well play billiards with bean bags. Of course, at the start of the paragraph, reference is made to 'inelastic bodies.' What does this mean? Putty might be a good example."

Not being up on our physics and not having any billiard balls handy to try the stunt, we passed the buck to Eugene C. Clarke, president of the Chambersburg Engineering Company. After all, we lifted the statement about the balls from Chambersburg literature describing its new "Impacter" forging machine. Mr. Clarke got us off the hook nicely with the following:

"The laws of impact, credited, I believe, to Sir Isaac Newton, are recorded in modern language on pages 8-23 of the Eleventh Edition of Kent's Mechanical Engineers' Handbook. They also appear in most engineering textbooks.

"And, I'm old enough to have witnessed the experiment of two honest-to-goodness ivory billiard balls suspended on strings and colliding and coming to rest. It was a common experiment in our physics lab, and the billiard balls were almost perfectly inelastic. It's that quality that makes them bounce well. I wonder if Mr. Miller is thinking of rubber bands when he thinks of elasticity? Anyway, the machine works."

We got out of that trap all right, but another reader, a test engineer who remembers his physics, informed us that the statement that "energy is the product of mass times distance traveled" is not strictly true. Energy, he tells us, is the product of force times distance traveled, and force, in turn, is the product of mass times acceleration. Then, without the help of readers, we discovered a "boner" in the caption under the pictures on page 14. We said that an "Impacter" forges 40 jet-engine blades an hour. Actually, the new machine smacks out 40 a minute.

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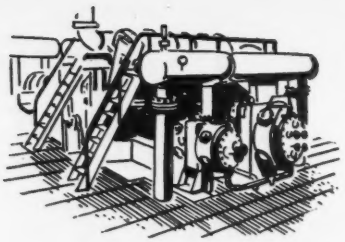


Stretching the St. Louis Gas Supply

Laclede Company Increases Propane-Air System to Supplement Natural Gas During Winter Peak-Demand Periods

Lee M. Liberman

THE GAS-LIGHT ERA

Laclede was formed as The Laclede Gas-Light Company and retained that name until recent years. It did a lot of gas-lighting in the early days and even generated a little electric power. Shown is a 1913 view of 3-mantle Humphrey arc lights in the factory of the Angelica Jacket Company on Ninth Street, St. Louis, Mo.

MOST Americans are unaware of the fact that one of the nation's oldest industries has suddenly entered upon a new era of tremendous growth. It might even be said that the gas industry itself has not yet fully appraised the rejuvenation and revitalization it is undergoing. The executive leadership, which in the not too distant past was extremely pessimistic about future development, is today finding it difficult to comprehend the virtually unlimited possibilities for expansion.

Fundamental to this boom is the industry's relatively new product, "natural gas." Prior to World War II gas for househeating was a premium fuel for which some people were willing to pay extra. As city after city throughout the country converted from manufactured to natural gas, gas men discovered that gas is a premium fuel which they need not sell at a premium. The pattern varies somewhat across the nation, but in many localities natural gas costs less than either oil or solid fuel, with the result that the demand for gas heat has become insatiable.

It can readily be appreciated that the effort to meet this demand is accompanied by formidable problems. Perhaps the industry's growth and the nature of the difficulties involved can best be understood by investigating the activities of a company that is in the midst of solving these problems and whose history closely parallels that of others in the field.

The Laclede Gas Company of St. Louis, Mo., typically exemplifies the present metamorphosis. It is almost a century old, having been incorporated in March of 1857. At one time four separate gas companies served St. Louis, but by 1889 Laclede, through consolidations, emerged as the city's single gas utility. Initially incorporated to supply gas for lighting, the organization, like the industry as a whole, was dealt an almost fatal blow by the introduction of electric light. Recovery was achieved through increased sales of gas for cooking, and later Laclede expanded through the use of gas for other domestic purposes such as water heating and refrigeration.

Up until 1932 the concern distributed 600-Btu gas manufactured in coke ovens, retorts and carbureted-water-gas sets. That year its retort operations passed out of the picture and its system was converted to handle 800-Btu mixed gas composed mainly of 1000-Btu natural gas and 500-Btu coke-oven gas. On peak days the supply was supplemented by producing carbureted water gas. That conversion brought about a modest demand for gas for househeating, but the noncompetitive position of the fuel, coupled with the depression, prevented a rapid rise in sales for this purpose.

During the 30's the company became increasingly aware of the fact that geographical limitations hampered its growth. Its franchise area was confined to the City of St. Louis, which had established restrictive boundaries in 1876. By 1930 the suburban region of metropolitan St. Louis extended well beyond those confines and was becoming more and more populous. Gas franchises for that area were held and exercised by The St. Louis County Gas Company, and it was realized that Laclede's chances of gaining new customers would be slim unless it could purchase that company.

Laclede's financial history during 1926-1945 closely parallels that of many of the nation's utilities. It became a part of holding-company systems and was subjected to the usual abuse heaped on those systems. The depression virtually ruined the holding companies but also brought about ameliorative Federal legislation in the form of the Public Utility Holding Company Act of 1935. This act forced the parent company to divest itself of its properties, and in 1945, after the consummation of a financial reorganization, Laclede emerged as an independent concern largely under local management.

In the meantime, it had been decided to convert to straight natural gas as soon as possible. Many factors led to this decision, but the primary one was the great potentiality of the space-heating market and the company's inability to supply that market with mixed gas. World War II and the resultant material shortages were responsible for the delay in carrying out this phase of its 3-point program: to strengthen itself from a financial as well as an operating viewpoint; to acquire The St. Louis County Gas Company; and to change to the distribution of straight natural gas.

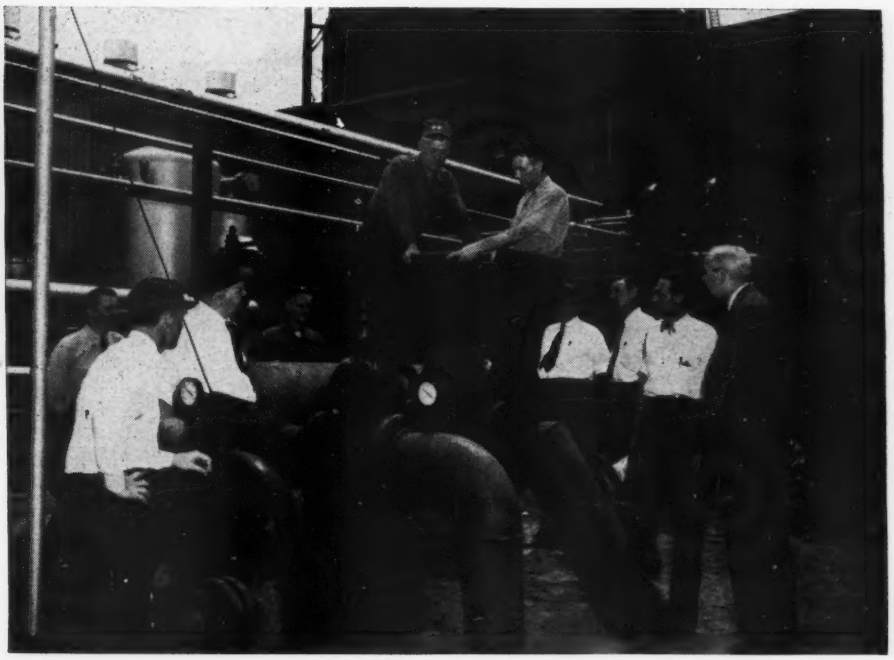
Through reorganization Laclede partly accomplished the first of these objectives and has continued to gain operating strength since then by putting more technically trained men on its staff. Financial improvement has, of course, gone hand in hand with the company's growth. By 1947 arrangements had been completed for the purchase of The St. Louis County Gas Company. This removed the geographical restrictions that

OFFICE BUILDING

This structure on Olive Street in downtown St. Louis houses the company's general offices.

INAUGURATING NEW SERVICE

Scene in 1949 as anxious Laclede officials and engineers watched workmen turn valves that converted the first section of the distribution system from mixed-gas to natural-gas service.



had prevented expansion and was followed by a marked increment in customers within the area formerly served by St. Louis County Gas.

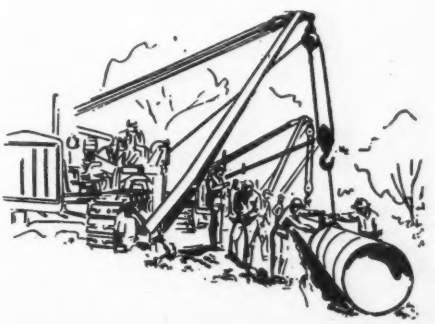
As a prerequisite to the third objective, Laclede had to provide itself with an increased volume of natural gas, and in October, 1947, negotiated a 19-year "requirements" contract with its supplier, the Mississippi River Fuel Corporation. Conversion of its system had to await completion of Mississippi's expansion program, which involved the laying of a second pipe line from Perryville, La., to the St. Louis area. In May, 1949, when it became apparent that the line would be ready prior to the 1949-50 heating season, conversion of the distribution system was begun. This work entailed the adjustment of more than 775,000 individual gas appliances and was finished in December, 1949, on schedule.

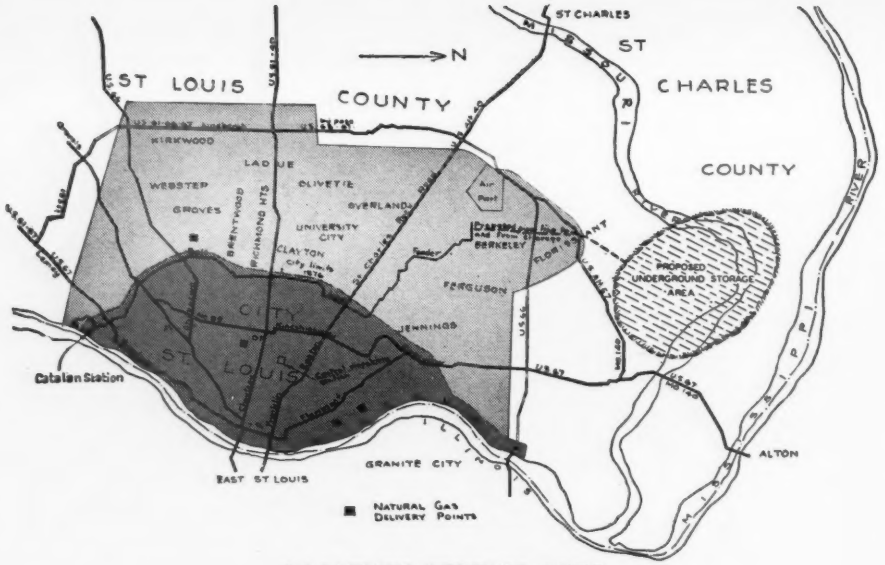
Laclede's growth since the changeover to straight natural gas has been phenomenal. Gross revenues have advanced from $15 million in 1948 to approximately $30 million in 1952. The number of residential househeating customers has jumped from 27,000 in 1948 to 112,000 as of January, 1953. Annual sales have increased from 17 billion cubic feet in 1948 to 40 billion during the twelve-month ending December, 1952. Peak-day sendouts have risen from 100 million cubic feet per day in 1948 to an estimated 359 million cubic feet per day this winter. The extent of this growth is still more remarkable when it is considered that during the greater part of the period involved the company could not obtain sufficient quantities of natural gas to enable it to take on additional business.

To insure service on such an expanded scale, it has been necessary to invest more than $28 million in new facilities since 1947, and this, together with increased sales, has been accompanied by increased annual expenditures for operation and maintenance. At present more than 2300 people are employed, as compared with about 1700 in 1948. In addition, there has been an appreciable growth in the use of labor-saving-machinery, and the automotive fleet of more than 550 vehicles has been generally modernized. The latter includes 21 trucks carrying air compressors, fourteen trucks equipped with welding machinery and twelve trenching machines, as well as several cranes and tractors. The company has also brought many of its office procedures up to date, and at the end of 1952 had virtually completed conversion of billing and accounting to I.B.M.

Naturally, expansion on the tremendous scale cited has been accompanied by many problems that fall mainly into two categories: distribution and supply. Laclede's distribution system required considerable reinforcement to enable it to handle more than three times as much gas today as it did only four years ago. It is probably no exaggeration to say that few distribution networks have been subjected to the intensive study the one under consideration has received. Because of this planning and the resultant construction it was possible to keep the system abreast of the heavy demands made upon it and to secure the greatest benefits from the huge expenditures involved.

Reinforcement was needed both locally and systemwide. In the case of the latter, the major problem arose in conjunction with the taking of gas from the supplier at the southern edge of the system and transporting it for de-





LACLEDE'S SERVICE AREA

The shaded parts indicate the territory the company supplies with gas. The darker portion represents the City of St. Louis, which covers 61 square miles and has 850,000 inhabitants. The lighter area shows the section of St. Louis County that is served by the company and is experiencing the greatest growth in homes and population. Catalan Station, mentioned in the article, is at the lower-left. The site of the proposed underground storage reservoir known as Florissant Field is on the right. Geological investigations of the structure, financed by a $500,000 appropriation, is expected to continue until next fall. If the field is found to be suitable for storage purposes, it will enable Laclede to provide 50,000 additional househeating customers with gas and increase its annual income by about $5,000,000.

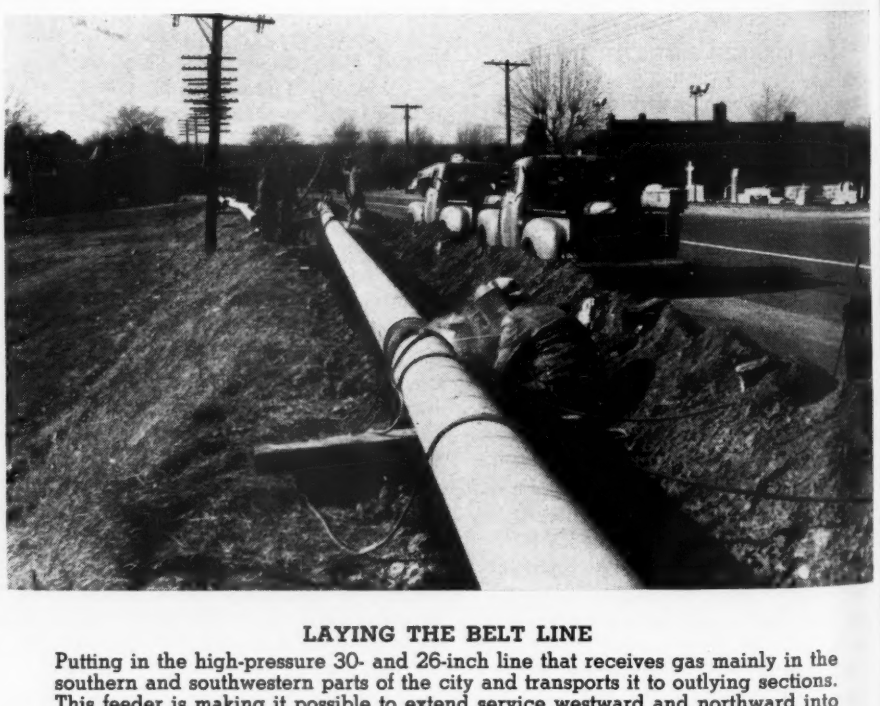
livery across the system. This difficulty was solved by designing and installing, in 1950, a 22-mile-long feeder belt line which extends from south to north across the heart of the company's service area. It is composed principally of 30- and 26-inch-diameter steel pipe. Although built to operate initially at 100 psig, the pressure will eventually be boosted to approximately 300 psig. Virtually all the increased deliveries made since conversion to natural gas have been transported through this belt line. Regulators installed at strategic locations throughout its length are remotely controlled from a central dispatching office. The entire main feeder system has been isolated electrically and is subjected to cathodic protection.

Gas supply has been an even more complex problem than reinforcement of the distribution network. Pent-up demand for space heating quickly exhausted the gas made available upon completion of Mississippi's second pipe line. Additional compressor horsepower stationed along this line enabled it to carry a larger volume, but that, too, was exhausted by the 1950 load. In order to supplement its supply, Laclede modified its manufacturing facilities to produce 1000- instead of 800-Btu gas, and during 1946, 1947 and 1948 provided others to enrich its carbureted water gas to 1000 Btu and also to manufacture 1000-Btu propane-air gas.

Propane-air, as the name suggests, is a mixture of propane vapor and air. Propane is a saturated aliphatic hydrocarbon which, although a gas at normal temperatures and pressures, can be easily liquefied by the application of moderate pressure. Transported and stored in liquid form, it is readily vaporized into a gas having the relatively high heating value of 2520 Btu per cubic foot. When used to supplement natural gas, it is diluted to 1000 Btu by mixing approximately 60 percent air with 40 percent propane vapor. In 1949 several water-gas sets were converted to make 1000-Btu oil-gas. By the time the 1950-51 heating season arrived the company was equipped to manufacture daily 36 million cubic feet of gas with a heating value of 1000 Btu. During the same winter the pipe line of the Mississippi River Fuel Corporation was capable of delivering to Laclede 268 million cubic feet of natural gas per day.

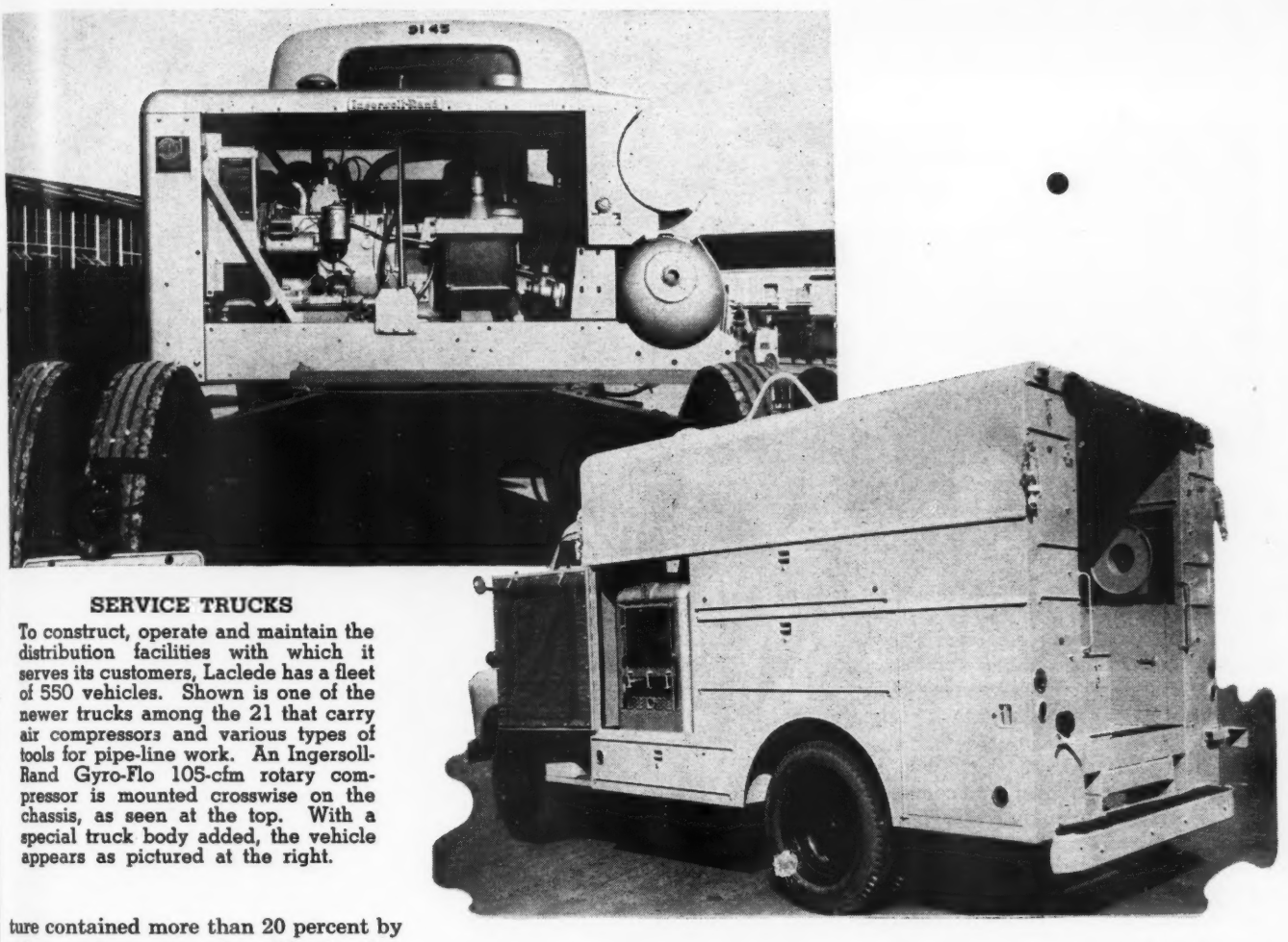
In the early part of 1951 it became apparent that despite its "requirements" contract, Laclede would not be able to obtain increased quantities of natural gas for the ensuing winter. Although it had already restricted load increments to commitments made prior to August, 1950, it was evident that it would take approximately an additional 25 million cubic feet to meet those commitments on a peak day during the winter of 1951-52. With no possibility of getting more pipe-line supplies, the company was faced with the necessity of providing means that would make up this deficiency. Some carbureted-water-gas sets that had not been converted to 1000-Btu oil-gas production were changed over and, when equipped with automatic controls and greater air-blower capacity, were capable of adding seven million cubic feet per day to the company's manufacturing capacity. That still left a shortage of about 18 million cubic feet.

Economics, coupled with the short time available in which to install equipment, dictated the construction of propane-air facilities to offset this deficiency. However, this created another problem, for Laclede's engineers felt that the introduction of propane-air into their natural gas would lead to combustion difficulties whenever the resultant mix-



LAYING THE BELT LINE

Putting in the high-pressure 30- and 26-inch line that receives gas mainly in the southern and southwestern parts of the city and transports it to outlying sections. This feeder is making it possible to extend service westward and northward into the growing suburban areas bordering the city limits.



SERVICE TRUCKS

To construct, operate and maintain the distribution facilities with which it serves its customers, Laclede has a fleet of 550 vehicles. Shown is one of the newer trucks among the 21 that carry air compressors and various types of tools for pipe-line work. An Ingersoll-Rand Gyro-Flo 105-cfm rotary compressor is mounted crosswise on the chassis, as seen at the top. With a special truck body added, the vehicle appears as pictured at the right.

ture contained more than 20 percent by volume of propane-air. Nearly that much was already being injected at all the principal points of natural-gas receipt except at the one which fed into the belt line.

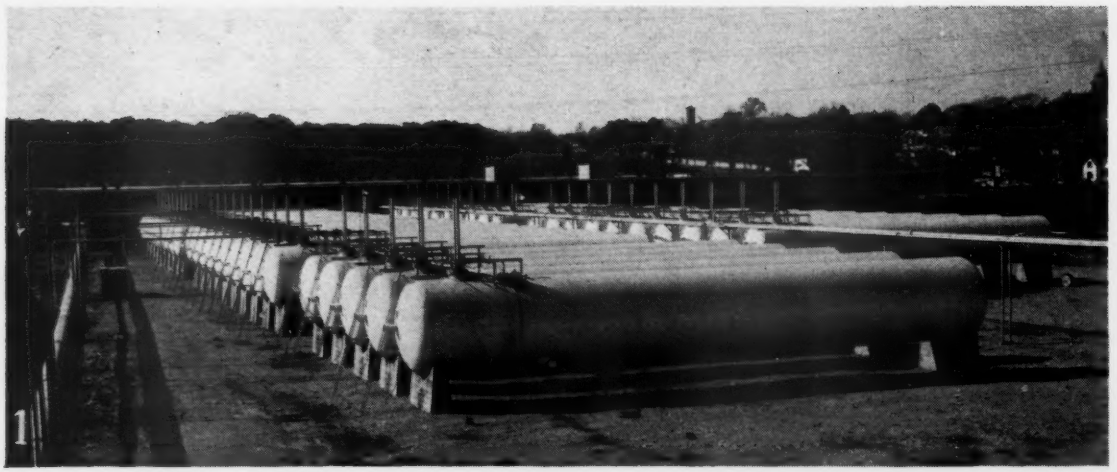
The introduction of propane-air into this feeder system meant the use of high pressure (125 psig in 1951, but eventually approximately 300 psig). To the company's knowledge there were no propane-air plants in existence of the contemplated magnitude operating at these advanced pressures. After careful study of the problem, however, there seemed to be no technical barrier to the success of such a plant, and it was therefore decided to build one with a daily capacity of 20 million cubic feet of 1000-Btu gas in the proximity of the belt line. The latter passed through Laclede's Catalan Street manufacturing plant which housed propane-air facilities capable of injecting 12 million cubic feet per day into the medium-pressure (25 psig) system. It was apparent that it would be possible to effect certain operating economies and to obtain propane-storage flexibility by locating the new establishment on property adjacent to the old one.

According to the plan, liquid propane would be delivered in tankcar lots and unloaded into standard cylindrical storage containers of 25,000 gallons capacity. From the latter the propane would be fed into heat exchangers and vaporized at 125 psig. Next, the gas would be superheated to approximately 60°F at that pressure, and then air at atmospheric pressure compressed to 125 psig by 2-stage compressors would be mixed with it in automatically controlled ratios. The resultant 1000-Btu gas would then be injected into the natural-gas stream flowing in the belt line. Looking to the future, it was also desired to make provisions so that the capacity of the plant could easily be doubled and gas at pressures up to 300 psig produced whenever it became necessary to work against higher pressures.

No particular problem was involved in unloading the liquid propane into storage, for that could be accomplished by electric-driven compressors at the Catalan Street site which would effect transfer by creating a pressure differential between tankcar and storage tank. No additional compressors would be needed. As it was calculated that around 825,000 gallons of storage would be required at the new plant, thirty-three 25,000-gallon containers were ordered and foundations and piping layouts were designed. Installation was started in the late spring of 1951 and brought the number of storage tanks at the Catalan location to 57.

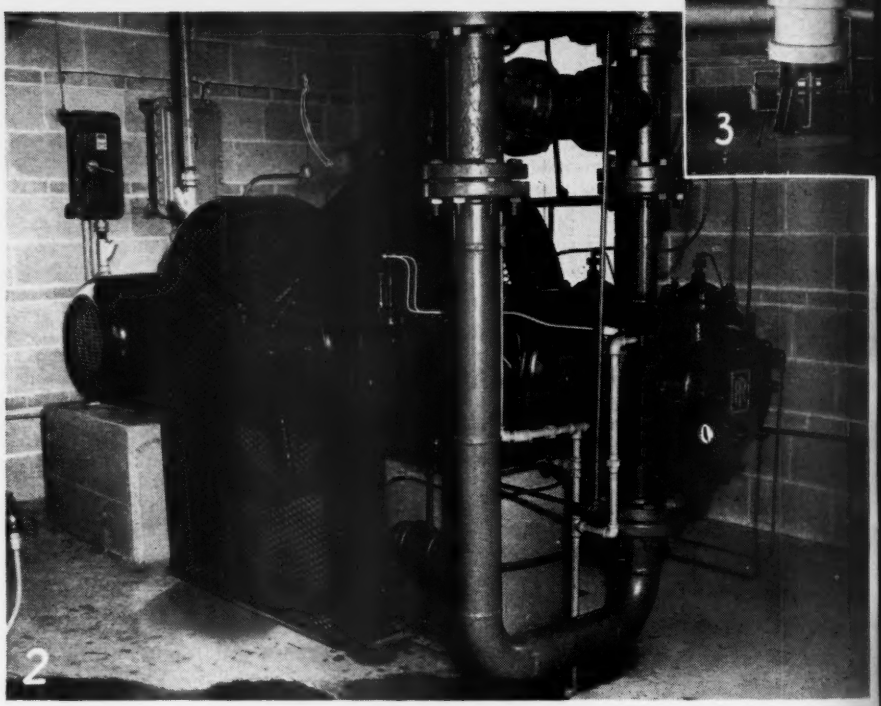
Because the liquid propane had to be vaporized at 125 psig and because the vapor pressure of that liquid is only 28 psig at 0°F some method of pressurizing the storage tanks had to be devised so that the propane would flow from them to the vaporizers. That was done by taking a small quantity of natural gas from the belt line, compressing it to the required degree and introducing it into the vapor space above the liquid propane in each container. Two Ingersoll-Rand compressors were purchased for this purpose: one 40-hp electric-driven ES-1 single-stage machine and one 40-hp steam-powered FS-1. These units serve as stand-bys for each other, since either one can do the job. The compressors will be active until the plant is called upon to operate at pressures above 250 psig, the maximum working pressure for which the storage tanks are designed. After that it will be necessary to resort to direct pumping of the liquid propane.

Three Griscom-Russell Company heat exchangers or vaporizers, each with a capacity of 7500 gallons per hour, are in use. The liquid propane is fed into the jackets of these units, where it is warmed and vaporized by contact with steam condensing in tubes running vertically through them. The propane vapor passes through baffles at the top of the exchangers and comes in contact with a thermal element that actuates a valve. The latter automatically controls the amount of steam condensate



removed from the vaporizers and thereby the temperature of the propane vapor leaving the exchangers.

Laclede selected three Ingersoll-Rand KVG 2-stage, 880-hp compressors with gas-engine drive to supply the process air for diluting the propane vapor. Each of these machines is capable of compressing 228,000 cubic feet of air per hour from atmospheric pressure to 125 psig. The compressor cylinders are provided with clearance pockets which will, in the future, make it possible to compress slightly smaller quantities of air from atmospheric pressure to 300 psig. The cylinders are also equipped with free-air unloaders which permit them to load and unload so as to maintain the desired output pressure. When all three units are operating at full rating they will require every hour approximately 25,000 cubic feet of natural gas as fuel. Compressed air at 250 psig for starting the engines is furnished by two 15-hp air compressors one of which is driven by an electric engine and the other by a gas engine.



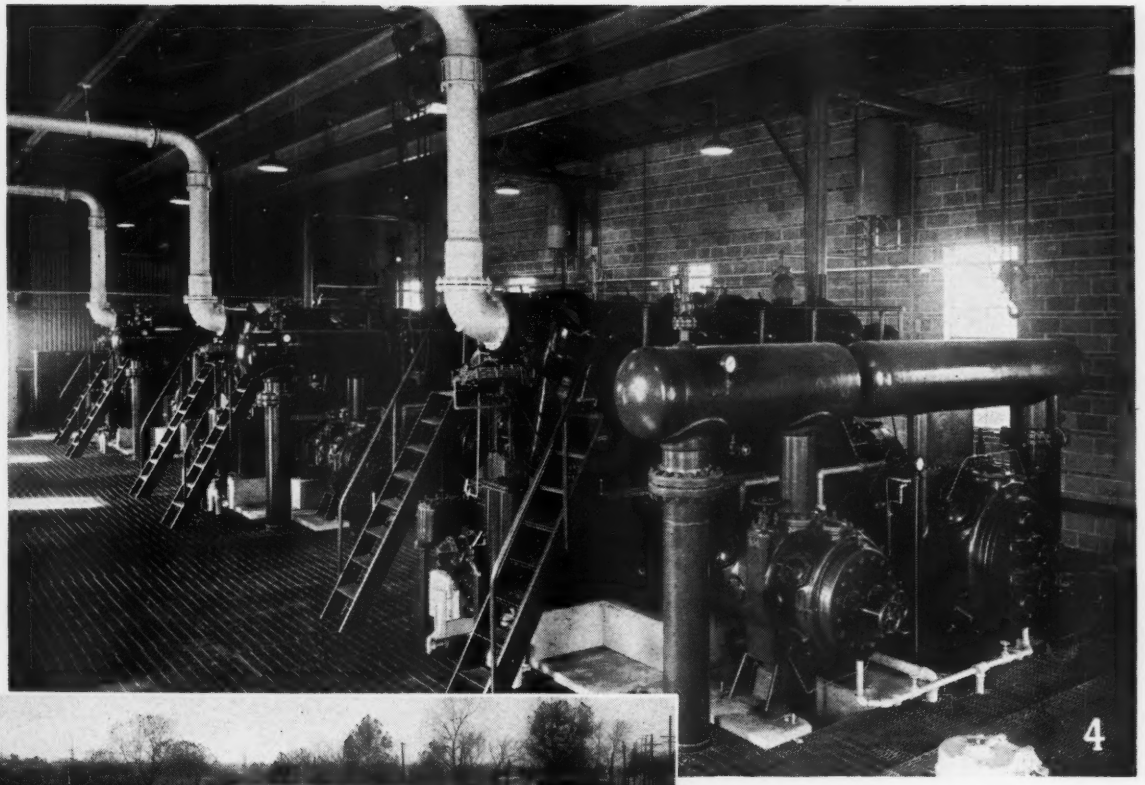
Because the propane-air facilities are normally needed only on a few cold days during the winter, a large investment in cooling towers and a closed water system was not justified. Therefore, the company buys city water for inter- and aftercooling and for oil and compressor-cylinder cooling. The engine cylinders are cooled by a closed system the water in which is, in turn, cooled by heat exchangers using city water.

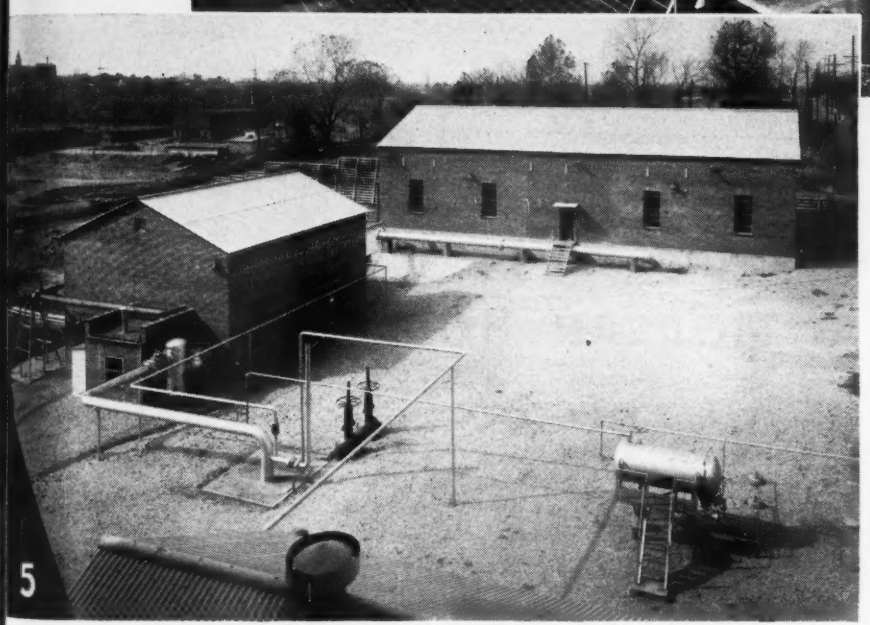
Propane-air mixing ratios are automatically controlled by means of Republic Flow Meters Company equipment. A regulator maintains a constant pressure differential across a butterfly valve which is installed in the main air process line and linked directly to a second butterfly valve in the propane-vapor line. Another regulator maintains a constant pressure differential across the second butterfly by controlling the opening in a turbine valve downstream from the propane vaporizers. Changes in the quantity of air consequently cause changes in the positions of the butterfly valves which, in turn, cause corresponding changes in the amount of propane vapor furnished for mixing.

In the event of failure of the propane supply, a third butterfly valve interposed in the air line upstream from the mixing apparatus shuts off the air supply. This valve is set to close when the pressure differential across the propane turbine valve drops below a predetermined minimum. The desired Btu rating is obtained by referring to a Ranerex gravitometer and a Cutler-Hammer calorimeter in setting up the desired differential values across the butterflies. Actual mixing of the propane and air is done in a simple baffled tank from which the gases flow directly into the belt line.

Two masonry buildings were constructed to house the necessary propane-air gas equipment. One is an air-compressor plant, approximately 100 feet long, 46 feet wide and 25 feet high, in which the machines are mounted on a common slab that is not tied into the building walls. Instead, concrete friction piles were placed beneath this slab and the footings of the structure to avoid, as far as possible, transmitting vibrations to the surrounding area. The second building is subdivided into three sections. The main or central one is about 35 feet square and houses the vaporizers and mixing equipment. The west wing is approximately 20 feet square and contains the two 40-hp compressors used in pressurizing the storage tanks. All the electrical wiring and machinery in these two sections is of the explosion-proof Class I-Group D type. The calorimeter and the gravitometer are in the east wing, which is about 10 feet square. A plate-glass window in the common wall between the latter and the middle section enables the operator to read values on these instruments while he is working in the central part of the building.

The new propane-air plant was completed in January, 1952, at an expenditure of approximately $1,200,000. As winter in the area was unusually warm that year, it was not necessary to operate the plant extensively, but it has had





1 Liquid propane arriving in tankcars is stored in this tank farm, consisting of 45 vessels, each 9 feet in diameter, 61 feet long and capable of holding 25,000 gallons. Twelve similar tanks are located elsewhere.

●

2 As needed, propane is transferred from the tanks to heat exchangers for vaporization. This is done by introducing compressed natural gas into the vapor space above the liquid and forcing the latter through pipe lines. The gas is compressed by the Ingersoll-Rand 40-hp electric-driven compressor shown.

●

3 Three Griscom-Russell heat exchangers, each with a capacity of 7500 gallons per hour, serve to vaporize the liquid propane. Circulating steam supplies the heat.

●

4 The vaporized propane, with a heating value of 2520 Btu per cubic foot, is diluted to 1000 Btu before being introduced into the natural-gas distribution system. This is done by adding compressed air in the ratio of 3 to 2. It is supplied by the three Ingersoll-Rand Type KVG gas engine-driven compressors shown. Each is rated at 880 hp and will compress 228,000 cubic feet of gas per hour from atmospheric pressure to 125 psi.

●

5 The equipment just described is housed in these buildings. Vaporizers, metering and mixing apparatus and the small compressor shown in No. 2 are in the structure at the left. The one in the background houses the three larger air compressors, along with starting air compressors and other auxiliaries. The function of the small tank in the foreground is to "odorize" the gas mixtures so it can be easily identified should any of it escape.

a thorough "shake-down" run and the company is well satisfied with its capacity to manufacture propane-air in quantity. It will, of course, be of permanent value, both as a supplemental gas producer in times of short supply and as an economic peak-shaving facility should Laclede in the future be able to obtain all the natural gas it can use.

The gas-supply problem continues to be a harassing one. This winter the Mississippi River Fuel Corporation pipe line made available an additional 32 million cubic feet per day, which has permitted a modest additional amount of space heating. However, it is estimated that there are still 100,000 residential customers within the service area who desire gas heat. There is also a large unfilled demand for both commercial and industrial purposes. Conservatively, the company believes that it could double its present load and send out in excess of 750 million cubic feet on a peak day if it could get the gas.

Laclede is exploring many possible avenues to augment its supplies. Towards that end it has embarked upon a program aimed at developing underground natural-gas storage close to its service area. If practical, the project will involve an outlay of $10 million and will provide gas for upwards of 50,000 more househeating customers.

The company doesn't know the ultimate solutions of the many problems with which it is confronted, but it has been in this fascinating business long enough to know that manufactured-gas men who consider natural gas a "panacea" and itself the solution of all the problems are in for a rude awakening.

HOSPITAL SEEN FROM THE AIR

There are five floors aboveground and two below. The structure at the left, with the stack, houses the boiler room in the basement and a laundry on the top floor. It is connected with the hospital by an underground passageway. The institution stands on high ground at the edge of the residential section where there is ample room for expansion.

Compressed Air is Used in Various Ways in

SUNBURY'S MODERN HOSPITAL

C. H. VIVIAN

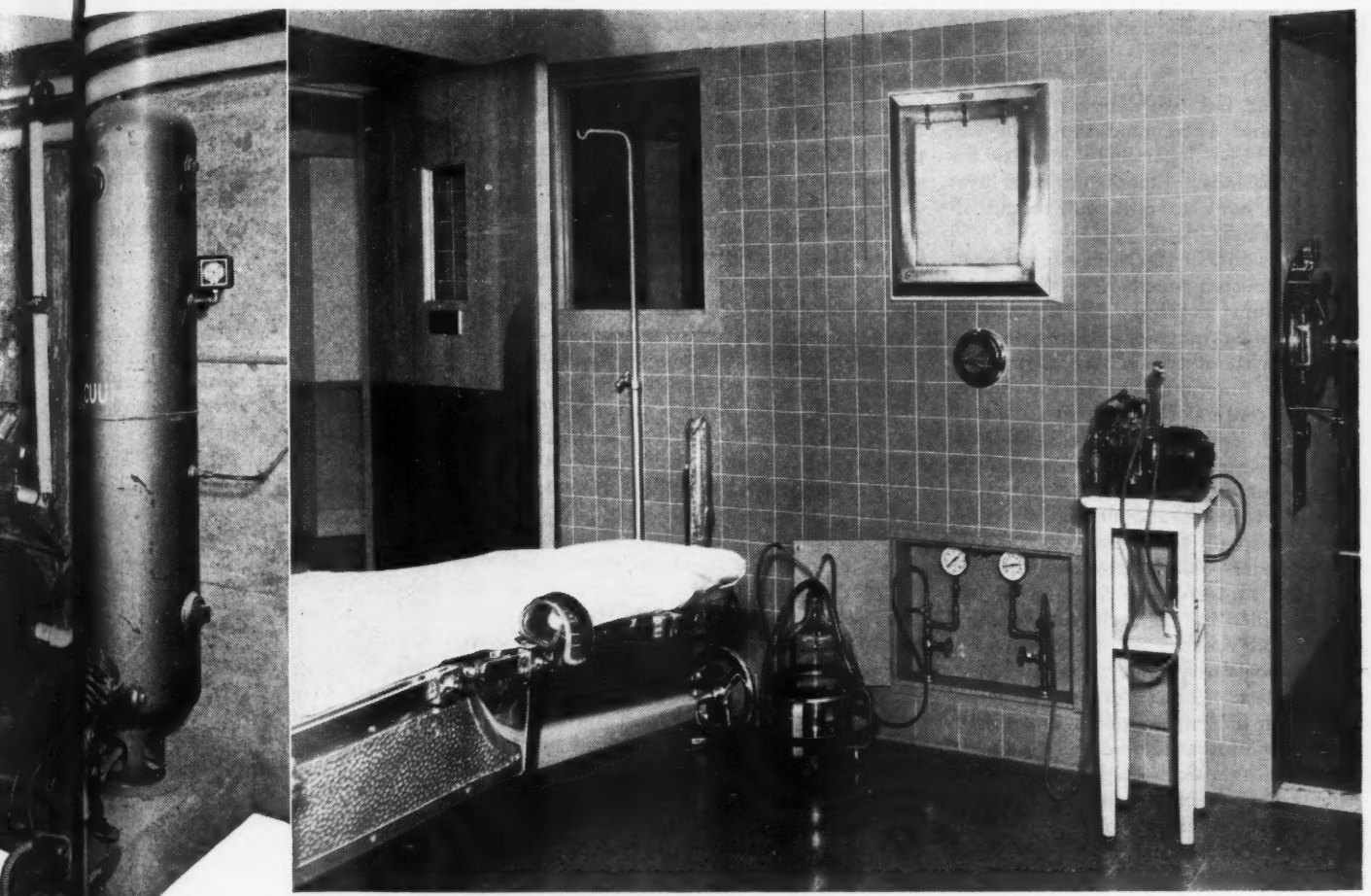
NOT many cities of around 17,000 population can boast of a $1,610,000 hospital, but there is one at Sunbury, Pa. It is an attractive fireproof, steel-skeleton, brick-concrete-and-tile structure of five floors, basement and subbasement situated at the edge of the city on a hill overlooking the Shamokin Valley. Step inside its portals and you can easily imagine you are in a first-class hotel or country club. Thanks to an efficient ventilating system and good insulation, no odors and no noise reach the public rooms; in fact, one can walk through the halls on any floor without noticing the telltale evidences of the old-style hospital.

Sunbury is in east-central Pennsylvania, about 60 miles north of Harrisburg and just south of the confluence of the Susquehanna River and its West Branch. It is in Northumberland County, but almost in the middle of an area formed by that county and three others: Union, Snyder and Montour. It serves all of them and is called the Sunbury Community Hospital. The region is supported by a combination of agriculture and industry. Sunbury's largest factory, with 4000 to 5000 employees, is the radio and television manufacturing plant of Westinghouse Electric Corporation. There are also several textile establishments, the major one being the Susquehanna Silk Mills. At nearby Shamokin Dam, on the Susquehanna, the Pennsylvania Power & Light Company operates what it calls the world's largest anthracite-burning power plant.

Sunbury has a legitimate claim to enduring fame in scientific circles because it was the birthplace of the electric light. On July 4, 1883, Thomas A. Edison illuminated a building at Fourth and Market streets with his newly developed incandescent globes. Current was supplied from the world's first 3-wire central generating station. Edison, who served as chief electrical engineer, mechanical expert and superintendent of construction, turned the plant over to the Edison Electric Illuminating Company of Sunbury. The Hotel Edison now stands on the site of the building that was lighted. It bears a bronze tablet, dedicated during Sunbury's sesquicentennial celebration, July 4, 1922, calling attention to the historical significance of the location. Some of the experiments that led to the creation of the commercial lamp were carried out in a shop that Edison maintained on Sunbury's Vine Street.

Another noteworthy local item is that Joseph Priestley, English chemist who first isolated oxygen and who is also said to have invented soda water, lived across the river in Northumberland from the time of his arrival in America in 1794 until his death in 1804. Priestley's invention of the "pneumatic trough" enabled him to collect gases and with them to promote the studies that brought him acclaim as a pneumatic chemist. His former home is a museum with a curator in charge.

Like most small communities, Sunbury had to work long and hard for its hospital. Three subscription drives conducted over a 7-year period brought in approximately one million dollars from individuals, industries and organizations in the four counties. Under the provisions of the 1946 Hill-Burton



OPERATING-ROOM SERVICES

Compressed air and vacuum outlets, with gauges for each, are visible in the wall recess at the lower right. The air outlet is connected by tubing with an ether bottle on the white portable stand. A valve permits adjusting the pressure, which is usually maintained at 2 psi for administering the anesthetic. The vacuum outlet, on the left side, is connected by tubing with a 5-gallon bottle on the floor. Other tubing extending from the bottle is used by a nurse assisting in an operation to draw off body fluids from incisions. The compressor and vacuum pump that provide these services are located in the subbasement and are shown in the center picture. Both are Ingersoll-Rand machines. The compressor (left) has carbon piston rings that do not have to be lubricated and therefore delivers oil-free air. It starts when the pressure drops to 20 psi and stops when it reaches 50 psi.

Act, empowering the Federal Security Agency to give one dollar for each two dollars raised locally, $510,000 was obtained from that source. And if the remainder of the pledges made are paid, the Government will add $20,000 more to its quota.

As often happens, the hospital plan grew far beyond its original dimensions. Initially, in 1943, it was thought that a $75,000 wing on the existing institution dating back to 1895 would suffice. Then it was realized that that would be only a stopgap at best and that the funds might better be used to build a new hospital. George W. Rockwell, president of the board of trustees, accordingly asked Lawrie & Green, Harrisburg architects, to draw plans for a structure that would cost no more than $200,000, which was then considered enough to provide adequate facilities.

That proved to be a poor guess, however, and when a closer check was made the figure was increased to $650,000. Meanwhile, a campaign to raise funds was launched in April, 1944, with $225,000 as the goal. A favorable response yielded $376,962. Then wartime shortages of materials and labor caused postponement of the project, and the estimated cost continued to rise as time passed. In 1947 another campaign was conducted with $400,000 as the quota and produced $410,000. The third and final drive came in the summer of 1950, by which time work on the structure had been begun. It brought in $224,489, approximately $75,000 short of the objective—$300,000.

Ritter Brothers, Harrisburg contractors, broke ground for the building on April 30, 1949, and it was dedicated on July 8, 1951. It was designed to answer future as well as present needs, and only about 65 percent of its 126 beds are now normally occupied. It is used by the 25 doctors of the community and has a nursing staff of 65 to 70.

The hospital is modern in every respect, with its own dial-telephone system, doctors' paging equipment and a standby generator driven by a gasoline engine to supply current for lighting in the event of a rupture in the power line from outside. From a spick-and-span kitchen on the ground or basement floor, food is transported to upper floors by two elevators and a dumb-waiter. On each patient's tray is a sealed container that keeps food hot or cold, as may be required, for several hours. The trays are loaded on carts that carry thermos bottles filled with different beverages. The staff has its meals in a cafeteria on the ground floor where storage spaces for supplies and an isolation ward are also located. There are supplemental diet kitchens on three upper floors.

On the first floor are business offices, a conference room and a state-supported clinic, including therapeutical equipment of various types. At the rear of the building is a receiving department for ambulance cases, with its own operating room for emergency use.

The second story is devoted to surgical and laboratory facilities. It has two general operating rooms, as well as separate ones for minor surgery, orthopedic cases and dental surgery. The extensive laboratories are completely outfitted, and a pharmacy is provided. The resident physician's quarters and

lockers for doctors and nurses are on this floor.

The third story is given over to obstetrics and has two delivery rooms, a nursery and accommodations for 30 mothers. The department handles its own admissions. Floors four and five are given over to patients' rooms of different kinds.

Out of sight, in the subbasement and in the connected basement of a separate heating-plant building, is dependable mechanical equipment that provides the services without which the institution could not function. There are found the nerve centers of the electrical, water, steam and sewerage systems, as well as three air compressors, one vacuum pump and various water pumps, the purposes of which will be explained.

An Ingersoll-Rand 2-stage, motor-driven, water-cooled compressor and an air-cooled motor-driven vacuum pump were specified by the architects to supply air and vacuum for use in surgery and medical treatment in accordance with modern hospital practices. The compressor has carbon piston rings that require no lubrication and consequently delivers oil-free air. At present the air is being applied in the operating rooms to pressurize ether administered to surgical patients. Suction produced by the vacuum pump draws off blood and other body fluids from incisions.

For these services some hospitals employ portable equipment such as a small rotary compressor, ether bottle and connecting tubing mounted on a stand that can be moved, as desired. Vacuum is obtained through a connection with the compressor intake. At Sunbury, the stand is utilized but not the compressor. Instead there are both air and vacuum outlets in a wall recess in each operating room.

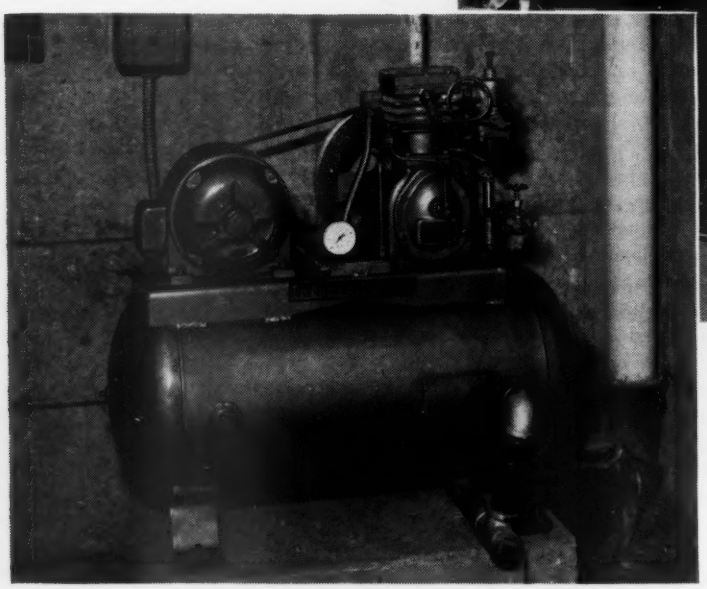
The compressor in the basement is arranged to start automatically when the receiver pressure drops to 20 psi and to stop when the pressure has been built up to 50 psi. The existing pressure registers on a gauge at each operating-room outlet, and there is a valve that permits adjusting the pressure of the air delivered which, for administering ether, is about 2 psi. Vacuum can be similarly adjusted. It is made available by running a tube from the wall outlet to a 5-gallon bottle and another tube from there to the operating table, where it is manipulated by a nurse. Compressed-air and vacuum outlets are also in the laboratories.

Although the doctors and surgeons at Sunbury are now using air in just the one way mentioned, at least two other possible services are being studied and may be adopted later. By far the more interesting of these is the application of pressure in the operation of the Bloxsom lock, a new apparatus that promises to reduce materially the death rate among newborn infants. It is the invention of Dr. Allan Bloxsom of Houston, Tex. Following its initial successful use at St. Joseph's Maternity Hospital in that city, it was adopted elsewhere and there are now 1250 units in service in this country, Mexico and South America.

It is designed mainly to overcome *asphyxia neonatorum*, which is the condition that exists when an infant's respiratory organs fail to begin functioning. Medical authorities agree that the first fifteen minutes of a human being is the most critical period. The Bloxsom Lock increases its chances of surviving this initial hazardous period.

About one out of every eighteen babies born is sufficiently asphyxiated at the time of delivery as to require some form of resuscitation. Prematurely born infants are more often affected than those that undergo normal gestation. If they are placed in the lock quickly—within fifteen seconds or so after delivery—a great many of them will survive.

The lock induces breathing by alternately raising the pressure on the body to 3 psi and reducing it to 1 psi. At the same time, oxygen is introduced under pressure and some of it penetrates the baby's skin and gets into the blood stream. Records of four months' experience with the lock at St. Joseph's Hospital show a decrease of 25 percent in the death rate of infants, as compared with the preceding year when the lock was not used. Obviously, the air entering the lock must be free of oil and other contaminants. For this reason the compressor that serves the Houston unit is of the same type as the one at Sunbury.



AIR-OPERATED LAUNDRY PRESSES

A combination of American Laundry Machine Company zarmoette presses is used to iron doctors' and nurses' uniforms, patients' pajamas and other garments. Air for operating them is supplied by a 1½-hp compressor (left).

Another use of oil-free air in some hospitals is the drying of instruments and laboratory utensils following cleaning. Elsewhere in such institutions compressed air can be employed for operating control instruments on boilers and similar equipment and for spraying paint and running pneumatic tools in maintenance work.

At Sunbury the upper floor of the boiler house is the hospital laundry, and there compressed air powers machines for pressing doctors' and nurses' uniforms. A separate Ingersoll-Rand 1½-hp motor-driven unit supplies the air. After being started each morning, the motor runs continuously during the shift in the laundry, while the compressor cuts out and in as pressure rises and falls.

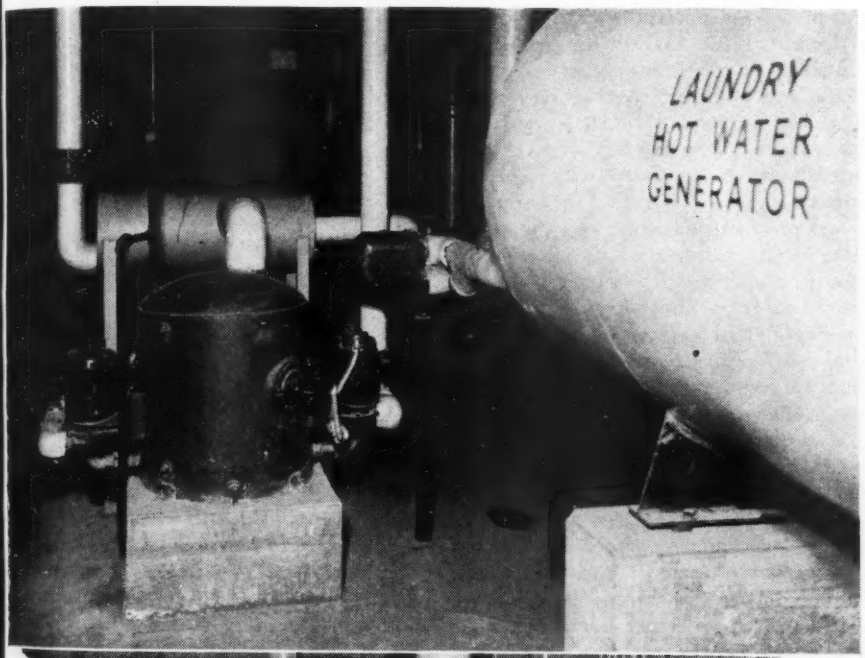
The third compressor in the building functions in connection with the water-supply system. The hospital is almost as tall as the city distribution reservoir. To insure adequate service, water from the city line is pumped into a 6000-gallon tank on top of the structure by two Ingersoll-Rand Motorpumps, each with a capacity of 150 gpm against 104 feet of head. One normally handles the load, but when water is being used faster than it is delivered, the second pump cuts in automatically and operates as long as it is needed. As the storage tank is not high enough to produce the desired pressure throughout the building by gravity flow alone, pressure of from 10 to 20 psi is maintained on the water with compressed air furnished by an I-R 2-stage motor-driven unit.

Steam generated in an anthracite-fired boiler is supplied at 50 psi pressure for various instrument-sterilizing and heating purposes and at 125 psi for the laundry. Boiler feed water is normally provided by a motor-operated pump, but a duplicate driven by a Coppus steam turbine is available for service in the event of power failure. Both pumps are I-R units, each with a capacity of 35 gpm against 312 feet of head.

Separate hot-water generators, in which heat is transferred from live steam, meet the needs of the hospital and the laundry. Condensate from the steam collects in a tank having a float that starts an I-R Motorpump when it rises to a certain level. The water is returned to the boiler feed-water tank.

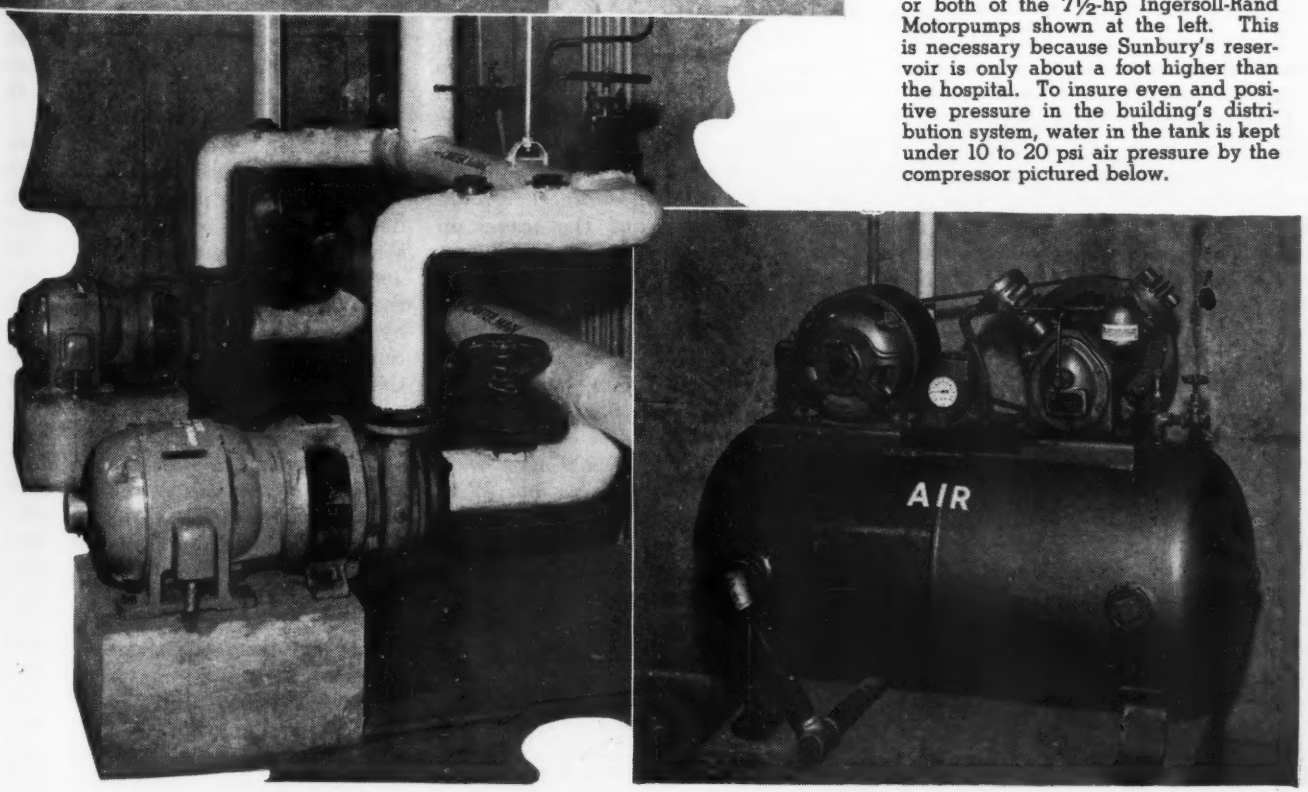
WATER-HEATING SYSTEM

Water for the laundry is heated by means of live steam, the condensate from which collects in the domed tank shown at the left. When the water in it rises to a given point, a float switch starts one of the two small I-R pumps mounted alongside the vessel. The condensate is returned to the boiler-feed system. A similar hot-water generator supplies the hospital's general needs other than those of the kitchen.



WATER-SUPPLY UNITS

Water delivered by city lines is pumped to a storage tank on the roof by either or both of the 7½-hp Ingersoll-Rand Motorpumps shown at the left. This is necessary because Sunbury's reservoir is only about a foot higher than the hospital. To insure even and positive pressure in the building's distribution system, water in the tank is kept under 10 to 20 psi air pressure by the compressor pictured below.



Open-Air Power Station

Kyrene Steam Plant of Arizona's Salt River Project Has Some Unusual Features

Robert J. Nemmers

A NEW steam turboelectric power plant, capable of producing up to 37,500 kw, is the most recent addition to a centuries-old project—the reclamation of the Salt River Valley of Arizona. Built to answer a long-time need for firm power and better service in that rapidly growing district, the Kyrene Station is located 12 miles southeast of Phoenix on the bank of the Western Canal of the Salt River Valley irrigation system, which was the first to be organized under the Reclamation Act of 1902. The compact, easily maintained plant was put in operation on June 1, 1952, and, with the exception of the control room, maintenance shops and auxiliary equipment, is an outdoor installation.

The demand for more power is largely attributable to the expansion of the surrounding area and is also a direct result of the recent water shortage that was partially alleviated only last year. Water for irrigation is so scarce and so valuable that its use for power generation is only incidental, and while four of the six dams on the project are designed to provide electricity, water from the storage reservoirs is passed through the turbines only when it is needed for irrigating crops in the valley below.

Reclamation in this area did not start with the passage of the Reclamation Act 50 years ago but goes back to the days before London and Paris were settled. Archaeologists estimate that the first migrants came to the valley as early as 300 B. C. By 600 A. D. they had established a flourishing civilization on the rich alluvial soil of the region.

Those "primitives" constructed irrigation canals as much as 20 feet wide, 10 feet deep and 6 miles long to irrigate an estimated 200,000 acres and to support a tribal system of nearly 50,000 people. So well did they survey the land in locating their canals that all many modern canal builders need do today is follow the old channels.

The Hohokams (people-who-went-away, as they are known) were a highly developed tribe. They lived in walled cities in order to protect themselves against marauders and were masters of the art of weaving, using mostly cotton grown in their well-irrigated fields. That they were also great traders is shown by the array of seashells obtained from Pacific Coast tribes. Those shells, used in religious ceremonies, were intricately carved and in cases etched with acids obtained from native cacti.

Around 1400 A. D. the Hohokams vanished, no one knows where, but two major and opposing theories have been advanced in explanation of their disappearance. One holds that a general drought drove them into exile to escape starvation, the other that a period of excess precipitation so raised the water table in the valley that the ground became too moist and vegetation literally drowned. The Pimas now in the area are descendants either of Indians that were left behind by the Hohokams or that appeared on the scene at a later date. One way or the other, no further irrigation or reclamation was attempted until the white man's ascendancy on the North American Continent.

In 1865 the desert region was occupied only by gila monsters, snakes and a lone Army outpost at Fort McDowell, the wandering Pimas only occasionally visiting their ancestral home. A year later an effort was made to harvest the rich grass growing along the banks of the Salt River and to sell the hay to the cavalry outpost. One of the men engaged in that venture attempted to dig a canal in 1867 but failed after encountering hard rock. But the following year when he chose another route he was successful, and that canal on the north side of the river was the start of the present-day development of the valley.

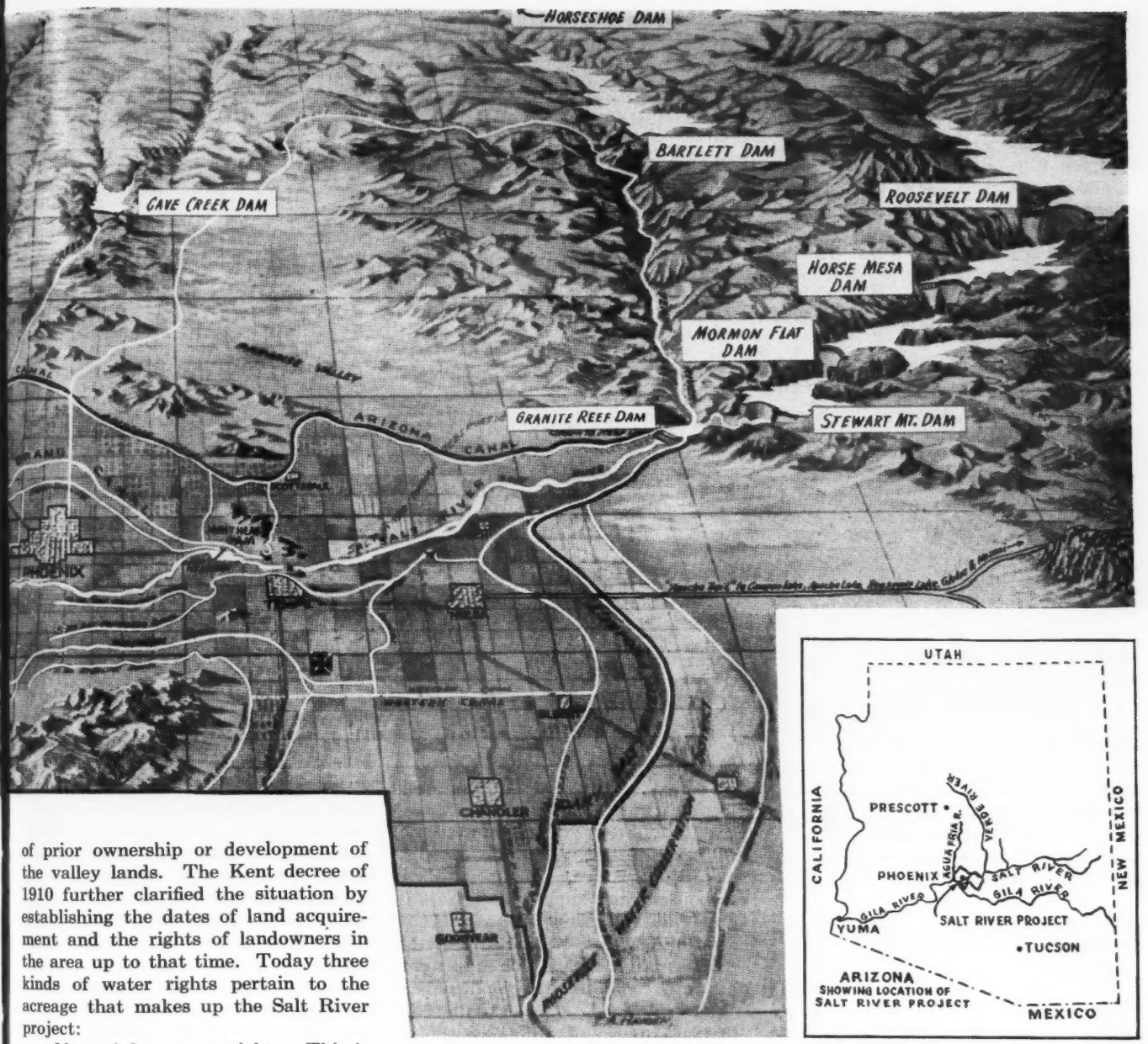
In 1870 another canal was completed on the Salt's south side, and in the next 30 years seven more were added. By 1872 a thousand families had settled in that part of the country, and by 1888 more than 100,000 acres were being cultivated under irrigation. With the increase in population, a city rose phoenixlike from the desert and was named after that mythological bird.*

In 1897 disaster struck the area in the form of a drought which lasted for many years. Phoenix was in danger of becoming another western ghost town annihilated not by the petering out of a rich ore vein but by the loss of food and dollar-earning water from the surrounding mountains. The drought made itself felt in the tempers of men who fought and sometimes died over the question of water rights which flared violently in the struggle for survival.

Finally, in 1900, farseeing men recognized that water rights were of no value without a plentiful and continuous supply and sent territorial representatives to Congress to plead for help and to offer suggestions. This led to the Reclamation Act of 1902 sponsored by several conservation- and reclamation-minded senators and representatives. The following year a coöperative —the Water Users' Association—was formed to negotiate the construction of a dam under the new law. In 1911 the first one was dedicated to the service of the valley and named in honor of Rough Ridin' President Theodore Roosevelt, long-time proponent of reclamation and conservation practices.

In the meantime, the matter of water rights had been clarified and settled, first in a decision submitted by Judge Joseph H. Kibby that recognized the principle of appurtenance—that water on or flowing through land belongs to the land. It also recognized the right

*The phoenix appeared to the ancient Egyptians singly and always as a male. When the bird was about to die, it built a nest around itself and set it afire, burning itself with it to the ground. From the ashes a new phoenix rose magically to repeat the cycle. Darrel Duppa, author and philosopher living in the Salt River Valley, drew from this myth the analogy that led to the adoption of the name for Arizona's capital city.



SALT RIVER PROJECT

Relief map that shows storage dams and main irrigation canals. Project lands are indicated by the darker shaded areas mainly in the lower and left-hand portions of the map. A cross (lower-center) indicates the location of the Kyrene steam generating station that is described in this article. Copper mining, additional manufacturing enterprises and new homes will consume most of its output. Salt River Valley's population has doubled in the past ten years, and 1500 new residents settle there in an average month. Building permits in Phoenix rose from a value of $2 million in 1941 to $20 million in 1951.

of prior ownership or development of the valley lands. The Kent decree of 1910 further clarified the situation by establishing the dates of land acquirement and the rights of landowners in the area up to that time. Today three kinds of water rights pertain to the acreage that makes up the Salt River project:

Normal-flow water rights: This is the first water right to the flow in the Salt and Verde rivers and is a prior right to stored water. These rights are dated from 1869 to 1909. Thus landownership registered in 1869 has first call on the normal flow of the streams, the 1870 developments have the next claim, and so on up to 1909.

Stored and developed water rights: All landowners in the Salt River Valley project holding Water Users' Association stock and who have signed water rights applications with the Federal Government have equal rights to stored and developed water. This right now covers the 242,000 assessed acres of the present project.

Pumped water rights: These rights are acquired under the same conditions as those in the preceding paragraph and may be so obtained until May 31, 1954. They entitle the land to an equal share of pumped water developed by the Association.

Six years after the completion of Roosevelt Dam, the Bureau of Reclamation turned the operation of the project over to the Water Users' Association. In 1923 the latter began active development of the lower waters of the Salt River and cast a speculative eye on the Verde, which joins the Salt just above the valley. In 1925 Mormon Flat Dam was ready for service, two years later Apache Lake was forming behind the 300-foot-high Horse Mesa Dam, and in 1930 the final step in the chain of reservoirs and power stations on the Salt River was concluded when Stewart Mountain Dam was dedicated. After coming through the depression of the 30's in sound financial shape, the Association completed Bartlett Dam on the Verde River in 1939. Seven years later Horseshoe Dam, also on the Verde, was added to the storage dams on the streams flowing into the potentially rich region.

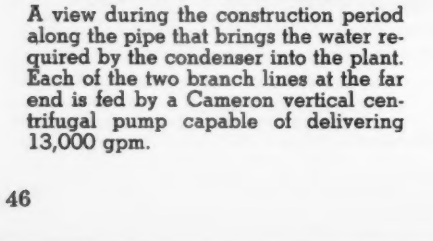
In 1951 the Association provided the valley with between three and five acre-feet* of water for each of the project's 242,000 acres. The supply was drawn from reservoirs with a capacity of 2,076,713 acre-feet and from 250 pumping stations scattered throughout the area. It

*An acre-foot of water is that amount which will cover one acre to a depth of one foot. This is equal to 43,560 cubic feet of water, or 325,828.8 gallons.

was distributed by more than 1400 miles of canals and laterals and helped to raise a record-breaking $64,928,827 crop. That was accomplished despite the low level of the water in the storage system at the beginning of the year—only 201,000 acre-feet. By carefully husbanding it and making more use of the pumping plants, the Association not only furnished sufficient water to produce the big crop but wound up the year with an estimated 1,097,621 acre-feet in storage and in the form of snow and ice on the mountainous watershed covering 13,000 square miles.

Power development in the Salt River Valley began at Roosevelt Dam with 25-cycle turbogenerators producing 24,000 hp of electrical energy. Each additional dam on the Salt was equipped with similar facilities until, today, there is a potential of 94,500 hp available at full flow. As has already been stated, this supply is not always obtainable because of water shortages and the necessity of reserving the precious fluid for irrigation. During periods of full flow, hydro plants at points of differential height in the canal system provide an additional 12,000 hp.

These stations gave the surrounding area a sufficient block of energy until 1936-37 when drought again struck the country. There was enough water to meet the needs of the fields, but the flow through the turbines was so erratic that the region suffered from a reduction in power. To relieve the situation, the Cross Cut Canal hydro plant was equipped with two 7000-hp diesel engines (then the largest in use in the United States) to operate during peak-load and low-water periods. Demand for electricity, however, soon made it necessary to put the huge machines, each turning a 5000-kw generator, on a nearly full-time schedule, and it was not long before they were running almost 80 percent of the time.

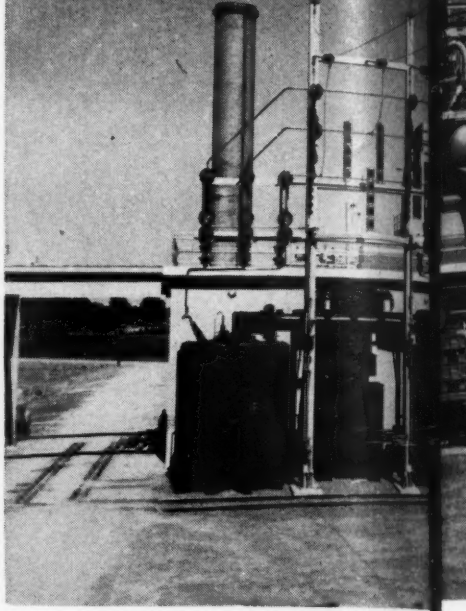


COOLING WATER LINE

A view during the construction period along the pipe that brings the water required by the condenser into the plant. Each of the two branch lines at the far end is fed by a Cameron vertical centrifugal pump capable of delivering 13,000 gpm.

MOSTLY OUTDOORS

The Kyrene Station is the first open-air power plant in Arizona. A favorable climate makes it possible to leave the principal operating equipment largely unprotected from the elements. The turbine is just above the roof line in the center, and the condenser is directly underneath it. The main entrance at the extreme right is framed by native sandstone walls. Inside are most of the auxiliary equipment, control room, chemical storage areas, laboratory and offices of the superintendent and operators, all air conditioned. There is also a commodious reception room. Efficient grouping of the various components makes it more compact than most stations of its size. The plant was in operation fourteen months after ground was broken for its construction. The 75-foot stack was prefabricated in two sections and erected on the site. The cooling towers, which are used in winter when water is especially scarce, are located a short distance from the powerhouse. Built of redwood, they can cool up to 19,600 gpm of water.



In 1940 the load had again so far outstripped the facilities that the Association installed a steam plant at the Cross Cut station. This consisted of three 100,000-pound-per-hour outdoor-type boilers which supply steam at 450 psi and 750°F to three 7500-kw turbogenerators. Because of lack of adequate shelter, partial roofs and side walls were added later to protect the maintenance men.

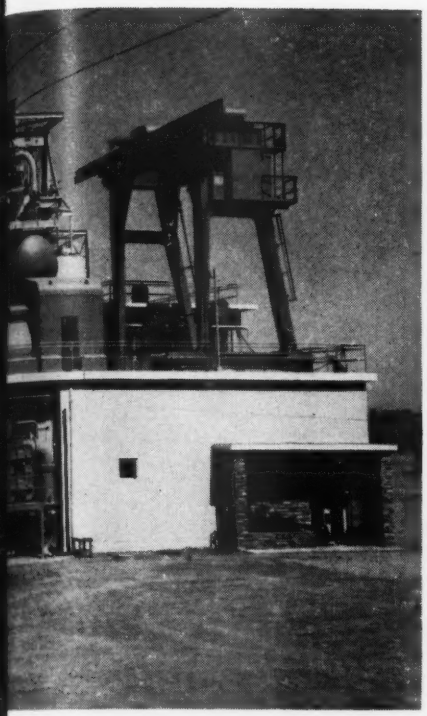
In 1946, to alleviate the power shortage growing out of the industrial expansion caused by World War II, a lease was taken on a 10,000-kw Navy power train—a complete plant which needs only fuel and cooling water to begin operation. It was run on a siding at the Cross Cut station and served until September 23, 1948, when it was hauled away.

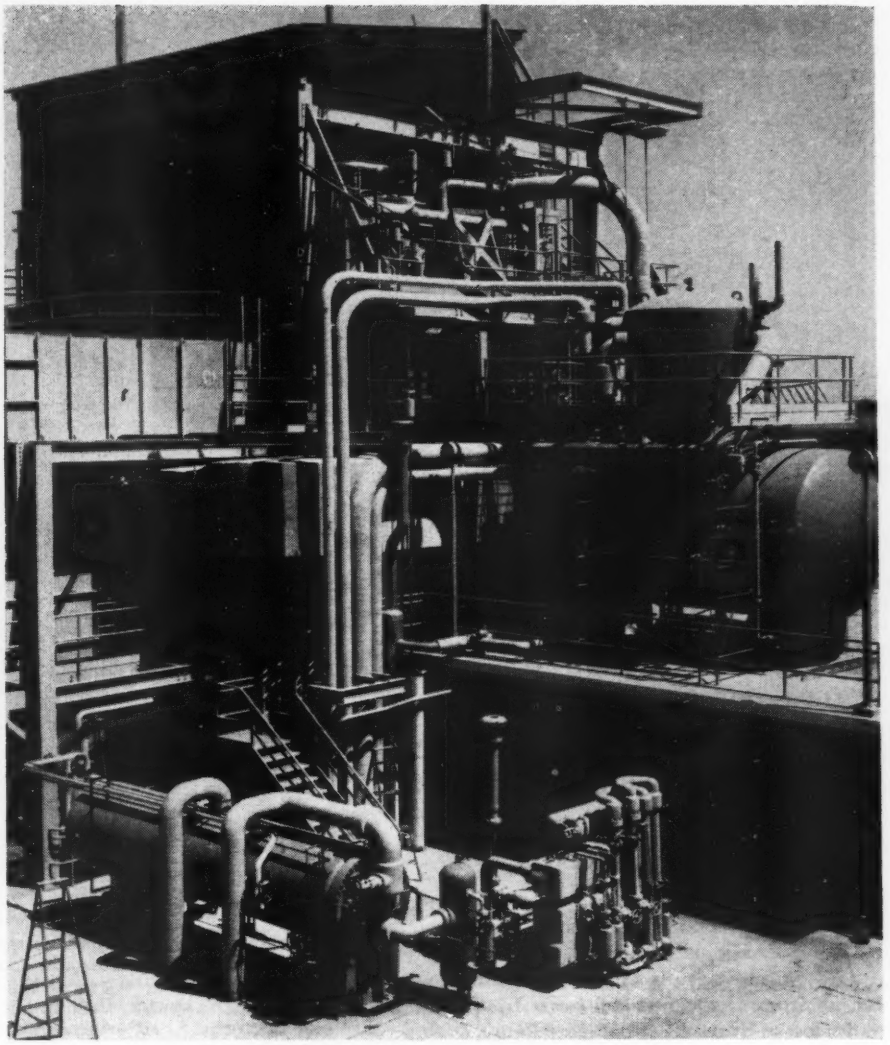
Three years later the control of the expanding electrical network was transferred to the Salt River Power District, a newly formed coöperative which concerns itself primarily with the production of electric energy for the valley. Starting out with an antiquated system with greatly overtaxed and rapidly failing transmission lines, the organization initiated a complete reconstruction program. This involved not only the conversion of the nonhydro stations to 60-cycle current, leaving the 25-cycle operation of nearby mines to the waterpower plants, but the rebuilding of the transmission line into a 204-mile, 69,000-volt high-tension distribution network. The region has greatly benefited by the improvements, for where there were once frequent power failures, the supply is now virtually uninterrupted.

In keeping with the project's policy of better service and more electric energy, work on the Kyrene Power Station Unit No. 1 was begun in 1951. Designed and built by the Bechtel Corporation, of Los Angeles, Calif., to take advantage of the area's climatic conditions, it is for the most part an outdoor installation. The furnace is equipped to burn natural gas automatically; fuel oil manually; or, upon conversion, coal or lignite, and supplies heat for a 350,000-pound-per-hour 2-drum bent-tube boiler manufactured by the Combustion Engineering & Superheater Corporation. The unit can operate at a maximum of 375,000 pounds per hour for as long as four hours should necessity arise for an extra-high production of electricity.

The boiler plant powers a General Electric turbogenerator with a nameplate rating of 30,000/33,000 kw, and by delivering steam at 925 psig and 905°F instead of the nominal 850 psig and 900°F has boosted the output of the generator to 37,500 kw. The latter is a 3-phase, 60-cycle, 0.5/15 psig hydrogen-cooled unit installed in full view on the second outdoor level of the station. It is protected by a walk-in housing.

The turbine discharges directly into an Ingersoll-Rand rectangular 2-pass condenser having 27,500 square feet of condensing surface. The latter has a vertically divided water box which permits shutting down half of the unit for maintenance while the other carries the load at a slightly reduced vacuum or higher back pressure. Two Cameron





STEAM-GENERATING EQUIPMENT

Close view showing the open-air nature of the installation. Below, at the right-center, are the steam-jet air ejectors that serve the condenser.

pumps handle cooling water at the rate of 25,800 gpm. Condensate is removed from the condenser hotwell by two 4-stage Cameron pumps that discharge through a steam-jet air ejector into the first stage of the regenerative feed-water heater.

Cooling water is obtained from the Western Canal during the summer months when it flows at near capacity and is pumped from a concrete intake reservoir at the rate of 26,000 gpm. In the wintertime, when it is almost empty, water is obtained from two wells, stored in a pond and pumped through the condenser. To save water, always a prime requirement in the area, it is circulated over a cooling tower and returned to the storage pond. Because the period of lowest load on the electrical facilities of the station coincides with the lowest water level in the canal, the size of the cooling tower and operating costs are correspondingly reduced. Moreover, the condenser cooling water drawn from the canal during the summer is cooler than that furnished by the tower, thus further increasing efficiency.

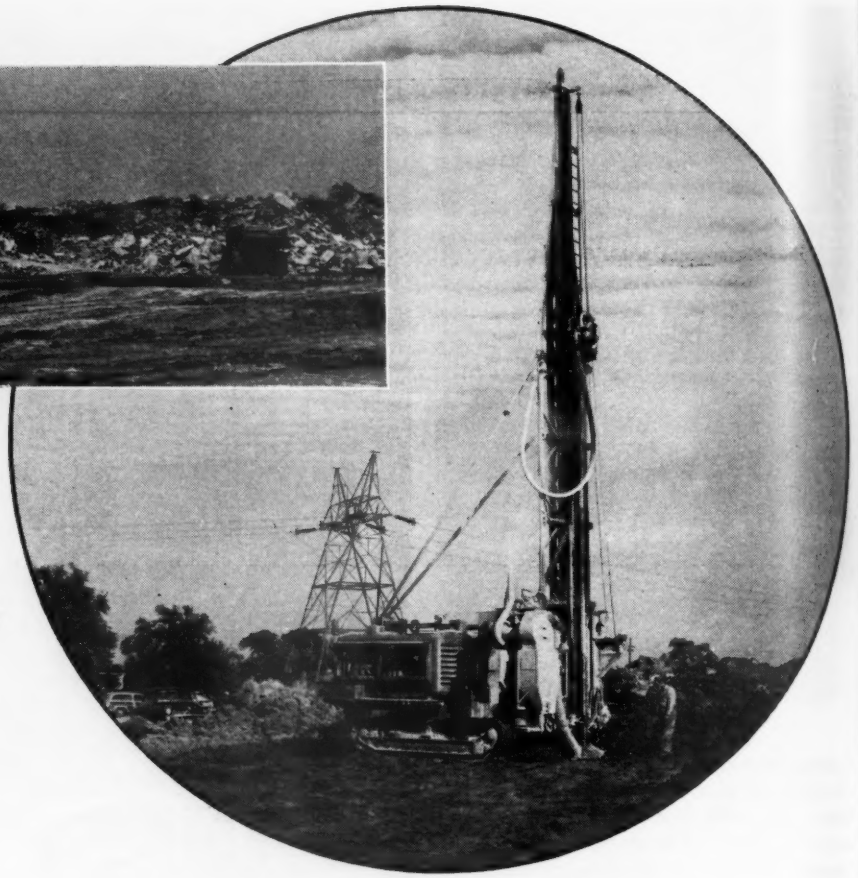
The plant site was chosen because of the availability of an adequate supply of cooling water, accessibility to rail lines and because it is centrally located in relation to the over-all project. The station, in general, is designed to harmonize with the valley's famed scenery. Exterior facings are painted buff and all machinery installations light green. The office and main entrance are constructed of native sandstone.

The control room, which is on the second level, is equipped not only to handle the mechanical and electrical components of the plant proper but also the switchyard with its incoming and outgoing electrical ties. It is maintained under positive pressure, which causes an outward flow of air that keeps out dust and also tends to keep employee efficiency at a high level in the hot dry climate. All ties are fully protected with carrier-phase comparison relays. Frequency changers are provided for converting incoming 25-cycle current from the hydro stations to a frequency of 60 cycles. Conversion can be reversed from 60 to 25 cycles should the demand for the lower-frequency power be greater than the normal supply.

In 1951, a total of 399,264,912 kwhrs was produced by the Power District and a block of 483,675,289 kwhrs was purchased primarily from the government-owned Hoover-Davis-Parker hydroelectric facilities, bringing sales for the year to 782,428,557 kwhrs. The completion of Unit No. 1 at the Kyrene plant, plus the increased amount of water stored in the reservoirs, should enable the District to buy less power this year from outside sources and sell more to its customers.

Although Unit No. 1 is the latest link in the historical valley's power-development system, it is not the last. Contracts have already been let for another unit at Kyrene with twice the capacity of the first. Except for size and some slight changes in design features, most of the equipment for it will duplicate that of Unit No. 1, but there will be no covering over the turbogenerator. Distribution facilities also are being increased, and a program for the modernization of the existing hydro facilities has been initiated that will considerably boost their power output.

Now celebrating its fiftieth anniversary, the Salt River Valley is in excellent shape, both financially and as to available water reserves. The plans formulated will take care of expected industrial expansion in the area, and a never-ending search for more water is being carried on. The Power District and the Water Users' Association are both looking forward to another 50 years of progress in the reclamation of the once desert-like valley of the Salt and Verde rivers.



Shifting Nashville's Freight Yards

Quarrymaster Rig is Drilling Most of the Rock With Rotary Bits

E. S. Williams

QUARRYMASTER AT WORK

This heavy-duty, self-contained, large-hole drilling machine is the work horse on the rock-excavation phase of the contract. After tests with both reciprocating and rotary movements, the contractor selected the rotary method because of its greater drilling speed. Drilling with the Quarrymaster on this job costs about five cents per cubic yard of rock broken, as compared with around twenty cents for wagon-mounted drills. A power shovel is shown at the upper-left loading spoil brought down by shooting a group of Quarrymaster holes. In this instance, holes were 6 inches in diameter, spaced 16 feet apart both ways and drilled from 20 to 30 feet deep.

AS PART of a $14,000,000 project to move railroad freight yards from the center of town to the suburbs of Nashville, Tenn., Codell & Oman, general contractors, have been digging away at 2½ million cubic yards of earth and rock since last June. The work, sponsored by the Louisville & Nashville and the Nashville, Chattanooga & St. Louis railroad companies, is now more than half completed. In addition to extensive grading, this relocation job involves the erection of seven concrete overpasses and the laying of more than 85 miles of trackage. There will be 82 tracks in all: thirteen for incoming and thirteen for departing trains and 56 for classification. Each will accommodate 160 cars.

The 2½ million yards of excavation and corresponding amount of fill are pretty well scattered over an area of approximately 2 miles by ½ mile of gently rolling country and consists of about 60 percent rock—sedimentary limestone of medium hardness—and 40 percent earth overburden from 2 to 12 feet deep. There is hardly any outcropping of rock, as the limestone lies in flat beds. The cuts are up to 40 feet in depth, with most of them between 20 and 30 feet deep.

All the major dirt excavation was finished last summer by a fleet of thirteen rubber-tired motor-scrapers. Since that time the contractor's main concern has been the drilling, shooting and removal of the 1½ million yards of rock. However, there was also a matter of 200,000 cubic yards of garbage that had to be handled, and that unenviable job was done with a 2½-yard shovel and rear-dump Euclids during the summer when the temperature was 100°F.

All the major grading is scheduled for completion by May, 1953. If progress continues at the current rate, this schedule will be met with ease and time to spare. The concrete overpasses were sublet to the R. R. Dawson Bridge Company of Bloomfield, Ky. Work was initiated on this phase of the undertaking almost as soon as grading was begun. At the time of writing, all seven structures were nearly finished.

When the work was started, the contractor moved in portable compressors and wagon drills in preparation for rock drilling. Because the cuts covered large areas and their average depth was more than 20 feet, it was decided that it would be more economical to put down holes 6 or more inches in diameter on 17x20-foot centers than 2-inch holes on 6x6-foot centers. The question then arose as to whether it would be cheaper to drill the medium-hard limestone with a percussion rather than a rotary drill. As there were no comparative figures available on drilling speed and bit life of a percussion versus a rotary drill operating in limestone, the contractor decided to find out for himself.

To do so, he purchased an Ingersoll-Rand Quarrymaster equipped with a QD-8 percussion drill and also a spare rotary-type drill head. The latter is a recent development for use on the Quarrymaster where conditions warrant. It consists of a heavy-duty air motor, reduction gears and spindle, all mounted as a unit on a slabback like the percussion drill. The two assemblies are quickly interchangeable. Both the rotary and the percussion drill use hollow steel in sections up to 40 feet long and utilize the exhaust air to clean the bottom of the hole by passing it through the steel.

For six weeks the percussion drill worked two 10-hour shifts a day six days a week drilling all holes 12 and more feet deep. Ingersoll-Rand X-type, 6-

ROTARY COMPRESSOR

This Ingersoll-Rand portable compressor of 600-cfm capacity driven by a diesel engine furnishes air at 100 psi pressure for operating two of the 4-inch drills on wagon mountings that supplement the Quarrymaster.

inch Quarrymaster Carset bits were used. The average over-all drilling speed, including time out for blasting, moving, servicing equipment and delays, was 31 feet per hour. Deducting the recorded delay periods such as blasting time, the actual drilling speed averaged a little more than 36 feet per hour. The amount of time spent in blasting was considerable, because at least one shot was fired each shift. This procedure was necessary to keep down the extent of the blast on account of the proximity of railroad tracks, power lines and houses. After this initial 6-week run, the contractor installed the rotary drill head, using standard Hughes 6¾-inch Tricone bits. Up to the present, the average over-all drilling speed has been 35 feet per hour and the actual drilling speed 41 feet per hour.

A comparison of the average life of the two types of bits is interesting. That of the 6-inch Carset was 3000 feet, as against 700 feet in the case of the 6¾-inch Tricone. It follows then that the percussion drill is more economical than the rotary drill in the medium-hard rock chiefly by reason of the much lower bit cost per foot of hole or yard of rock.

The foregoing figures might seem to indicate that there is little or no difference as to cost between the rotary and the percussion drill in this particular formation. The over-all drilling cost per unit volume of hole is, in fact, about the same for both. In considering the job as a whole, however, the rotary bit is more economical because of its greater drilling speed. Time is of the essence. Any drilling not done with the Quarrymaster will have to be done with wagon drills, so the contractor figures that the more he uses the rotary instead of the percussion drill, both of which he refers to as 5-cent-per-cubic-yard equipment, the more 20-cent-per-cubic-yard wagon drilling he will eliminate.

The field headquarters of Codell & Oman is a 16-room, 158-year-old house, one of Nashville's many historical landmarks. It was originally occupied by John Overton, a law partner of Andrew Jackson, and has been maintained in excellent condition through the years. The various residents have added wiring, plumbing and five baths, but the main structure is the same as it was more than a century and a half ago. It was included in the tract of land purchased by the railway companies, but as it is located in a secluded, wooded corner of the area it will probably not be torn down. Plans are underway to turn the structure over to the Tennessee Historical Society for use as a museum.

It is expected that the railroads will start laying track for the new freight yards around the middle of the present year. This job, for which special tamping and track-laying equipment will be needed, is to be done by the roads themselves. The entire undertaking is scheduled for completion by the summer of 1954.

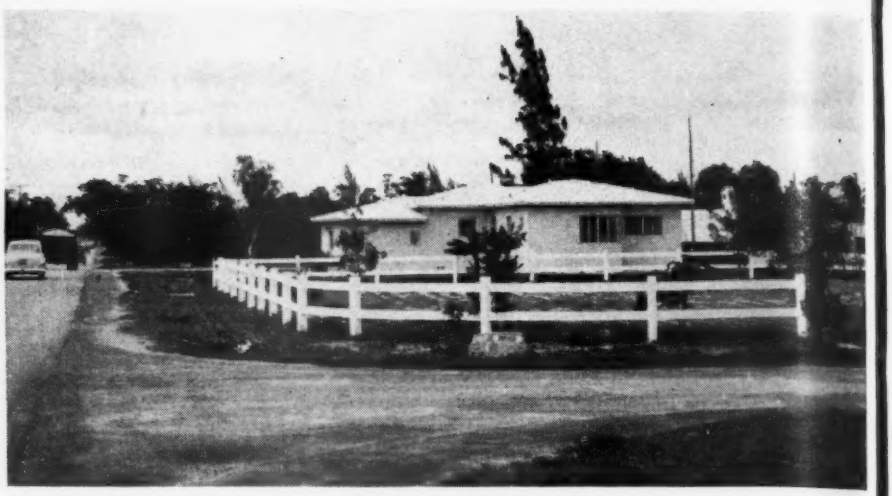
Many benefits will accrue to the two railroads, the public and the city of Nashville through the relocation of the freight yards on the outskirts of town. Improved rail service, of course, is one, and release of several acres of property in the heart of the city for industrial and commercial development is another. Furthermore, the project ties in with the city's long-range face-lifting program, which includes the erection of a highway bridge across the Cumberland River, the removal of many blocks of old buildings along the riverfront and the construction of an express highway through town and around the state capitol.

The main contract is a joint venture by the Codell Construction Company of Winchester, Ky., and the Oman Construction Company of Nashville, Tenn., which are furnishing the equipment for the job and supervising it on a 50-50 basis. John B. Callaway and Ralph W. Kirby are superintendents for Codell and for Oman, respectively.

OVERPASS SKELETON

A partially built concrete overpass, one of seven subcontracted to R. R. Dawson Bridge Company. In the shade of the trees at the right is a Gyro-Flo 210-cfm compressor that supplied air at intervals for operating Jackhamer rock drills, paving breakers, woodborers, backfill tampers, clay spades, sump pumps and other tools.

Concrete Fills New Roles



A FENCE OF CONCRETE

It is attractive, immune to termite attack, virtually indestructible and costs less than a dollar a foot. Both posts and rails are of concrete.

NUMEROUS precast building elements, ranging from room air-conditioner and window frames to fences and seats, have been developed by the Livesay Window Company of Miami, Fla., which has been able to sell them in competition with similar products of other materials largely because they are manufactured by a highly mechanized process in which compressed air plays a major part. It serves variously to operate the tools used in the assembly of the forms, to spray coatings on the forms before concrete is poured and to power vibrators that speed transfer of concrete from hoppers to forms.

Initially, the company produced only window frames for concrete-block structures and then expanded by including concrete fence posts when it became apparent that the latter would cost no more than wooden ones and would be immune to the attack of termites. A more recent addition is a mounting for small room air conditioners that are becoming more popular every year in southern climes. The frames are precast to specifications provided by the manufacturers of the cooling units and are set in the walls of buildings during construction. They cost little more than the blocks they displace and obviate the need of obstructing windows with sill-mounted conditioners. Another advantage of this method of mounting is that the frames may be put in position even if air conditioning is not wanted immediately, for the space can be plastered over inside and out and opened at a later date to make the installation.

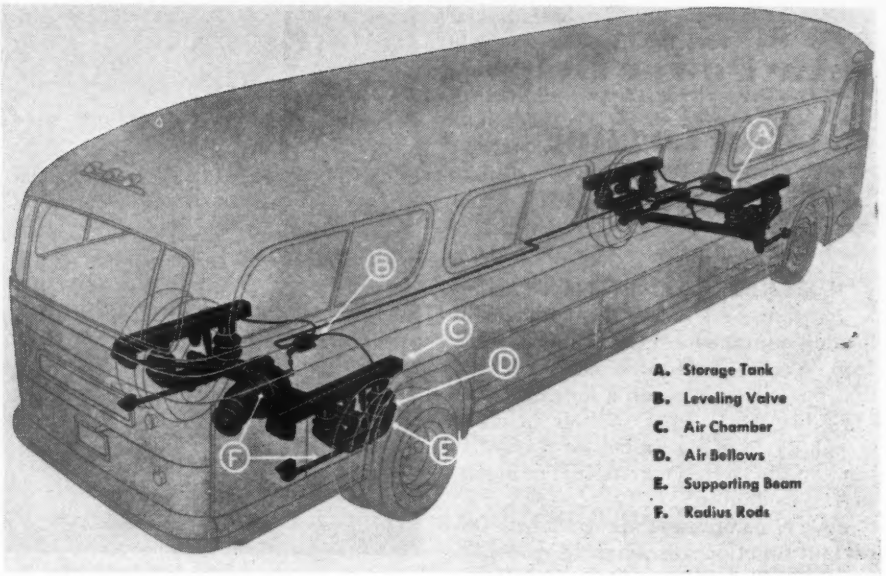
The Livesay Company has arranged a manufacturing system that is as close an approximate as possible to an assembly line. Aggregate and cement are transported to the top of a building where it is mixed, the concrete being dumped into hoppers from which it is fed to the pouring floor below through flexible hoses. Flow is assisted by vibrators, which are attached to the hoppers and literally jiggle the material through the feeders.

Poured forms are placed in a curing room in which live steam is circulated. This reduces the time required for the purpose from the usual 24 hours to about two. It also insures less shrinkage and finished products with fewer cracks than when the work is done by baking or dry heat. All precast structures are given a biweekly quality control test by an independent laboratory. Reports show that samples taken three and eight days after hardening have a compressive strength of 4900 psi and 6243 psi, respectively. The company's minimum requirements are 4000 psi at the end of the first period and 5500 psi at the end of the second.

PLANT OPERATIONS

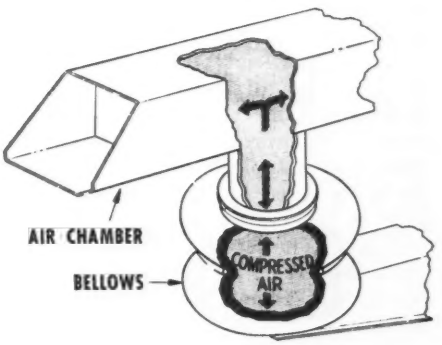
Forms are air-sprayed (left) with oil prior to their use in order to facilitate their removal later on. Then they are filled with concrete delivered by a canvas pipe that is maneuvered by hand as shown at the right. The worker's upraised hand holds a line attached to an air-powered vibrator that promotes the flow of concrete from a hopper.

Air Springs Make All Roads Smooth



PHANTOM VIEW

Principal elements of new air-cushion suspension system that will, it is claimed, prevent fatigue on long bus trips. General Motors engineers worked on the system for twelve years. A cutaway view of a bellows is seen at the right.

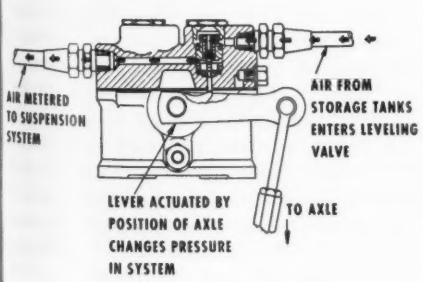


A NEW type of motorcoach body suspension that uses air instead of leaf springs has been developed by the Truck & Coach Division of General Motors Corporation. As a result, passengers on some new GM buses may get the smoothest of all rides on bellows made of rubberized-nylon tire fabric containing compressed air. The equipment will, for the present, be applied only to a new coach—Model PD-4104—a 41-passenger vehicle that combines practicality for operators and unusual comfort for riders.

It is claimed that air suspension will iron out highway irregularities so much that passengers will be able to read newspapers without the constant jiggling now experienced when traveling over rough pavement. The air, which is supplied by the compressor of the coach's braking system, is held captive in eight heavy flexible bellows, two to each wheel, which silently absorb road shock of all kinds from the sharp impacts of deep chuck holes to simple tire-tread vibrations. According to the engineers, the new body suspension has the following chief advantages:

First, air responds to the faintest vibrations, giving maximum benefits in the range of high-frequency vibrations where metal leaf springs fail to begin flexing because of friction between the leaves. Second, it makes possible a truly progressive rate of deflection because the more air is compressed, the greater is its resistance. In contrast, a metal leaf spring has a uniform rate of resistance throughout its deflection.

Leveling valves automatically meter compressed air into the system so that, as the coach is loaded, air pressure is increased to compensate for the added weight. This keeps the body at its normal level, providing easier and safer entry and exit for passengers. As the vehicle is unloaded, the leveling valves release air to keep the body at the same level.


AIR METERED TO SUSPENSION SYSTEM
AIR FROM STORAGE TANKS ENTERS LEVELING VALVE
LEVER ACTUATED BY POSITION OF AXLE CHANGES PRESSURE IN SYSTEM
TO AXLE

LEVELING VALVE

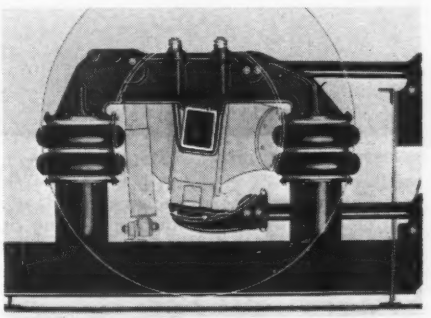
The volume of air in the bellows is varied according to the bus load, and the floor remains at the same level.

Tests conducted by GM engineers indicate that the flexible air bellows will last the life of the coach and that wear in any part of the system is inappreciable. Air suspension will, it is believed, materially reduce maintenance costs. It will not require lubrication because all joints are rubber-bushed, and body stresses will be lessened because road shock is more effectively absorbed. There are aircraft-type, direct double-acting shock absorbers on both sides of front and rear axles to control rebound and to further cushion the ride, while radius rods maintain the position of each axle against lateral, longitudinal and torsional movement. The radius rods are mounted on rubber, do not need lubrication, and are absolutely quiet.

While riding on air, passengers will be able to look through "picture" windows measuring 20x72 inches. Greater ease and safety in entering and leaving the coach are provided by a one-level floor with minimum wheelhouse projection. Both interior and exterior styling are new. With driver and a full seated load of 41 passengers, with 45 pounds of baggage for each and 100 gallons of fuel, the weight on the rear axle will not exceed 18,000 pounds, the legal load limit in many states.

Body suspension of buses had its beginning 30 years ago on "double-deckers" with solid rubber tires and progressive-type leaf springs with rubber shock insulation at the ends. From 1927 to 1930, the 29-passenger GMC coach had high-pressure (100 pounds) pneumatic tires and single-stage conventional leaf springs. In 1932 suspension engineers put on balloon tires (70 pounds pressure), increased the length of the spring leaf and made rubber shackles, all of which served to insure a much more comfortable ride.

Since that time, improvements in spring-leaf design, use of superior metals and better processing methods have resulted in easier coach upkeep and longer life. Progress also has been made in noise elimination. With the coming of "Air-Ride" suspension, maintenance and noise will no longer be matters of as much concern to operators as before.



DETAIL OF REAR SUSPENSION

Air Power Helps Run Logging "Donkeys"

COMPRESSED air has played an important part in the development of logging equipment since Skagit Steel & Iron Works of Sedro-Woolley, Wash., first put air controls on a logging "donkey" in 1926. That pioneer machine is still handling big timber for Rayonier, Inc., on the Olympic Peninsula of northwest Washington.

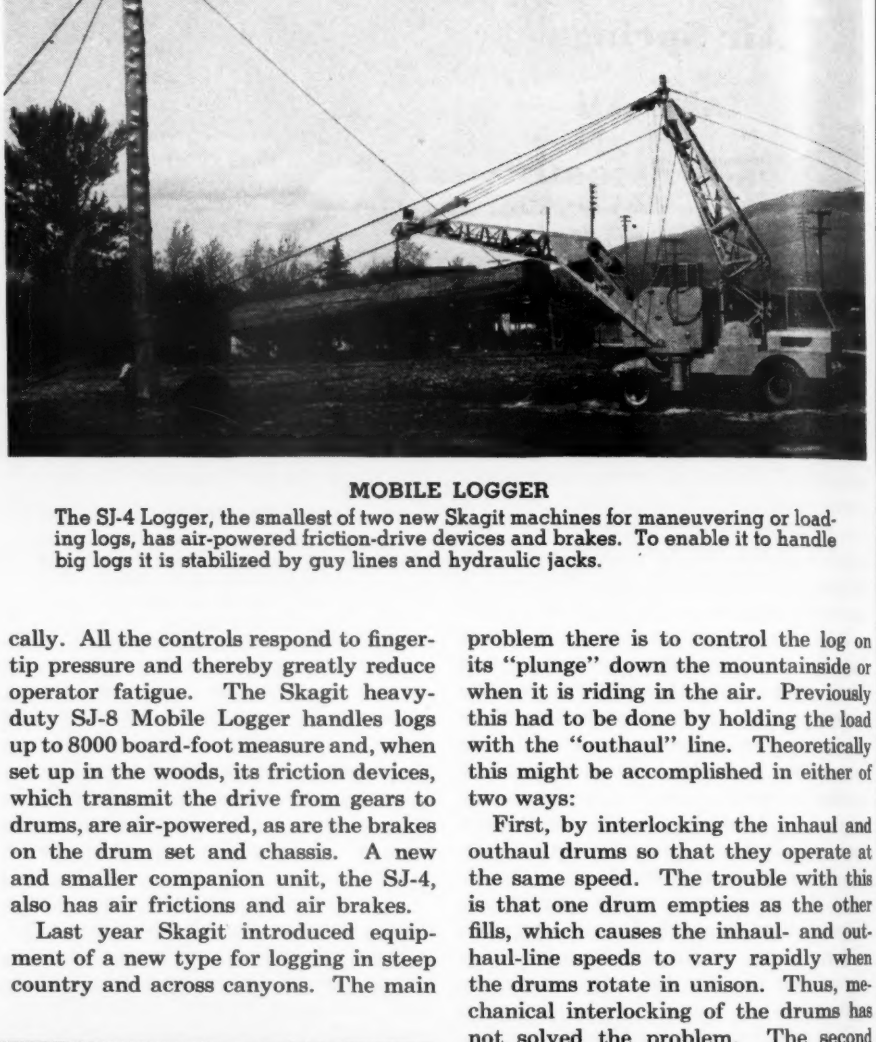
Today, compressed air performs important functions on Skagit Mobile Loggers, a new development in the industry, as well as on the powerful sled-mounted hoists that "yard" (collect and arrange) and load big timber. Pneumatic control of these hoists calls for quick-acting air valves and pistons to engage the drums and drive-gear frictions and to apply brakes. Compressed air is also used in Skagit clutch shafts and in effecting transmission speed changes. The latter are made quicker and smoother by air than by hand, thus eliminating engine stalling and jerky operation.

The logging machines are driven by gasoline or diesel engines ranging from 150 to 550 hp. In some of these power plants, operating temperatures are regulated by means of radiator shutters that are opened and closed pneumatically. All the controls respond to fingertip pressure and thereby greatly reduce operator fatigue. The Skagit heavy-duty SJ-8 Mobile Logger handles logs up to 8000 board-foot measure and, when set up in the woods, its friction devices, which transmit the drive from gears to drums, are air-powered, as are the brakes on the drum set and chassis. A new and smaller companion unit, the SJ-4, also has air frictions and air brakes.

Last year Skagit introduced equipment of a new type for logging in steep country and across canyons. The main problem there is to control the log on its "plunge" down the mountainside or when it is riding in the air. Previously this had to be done by holding the load with the "outhaul" line. Theoretically this might be accomplished in either of two ways:

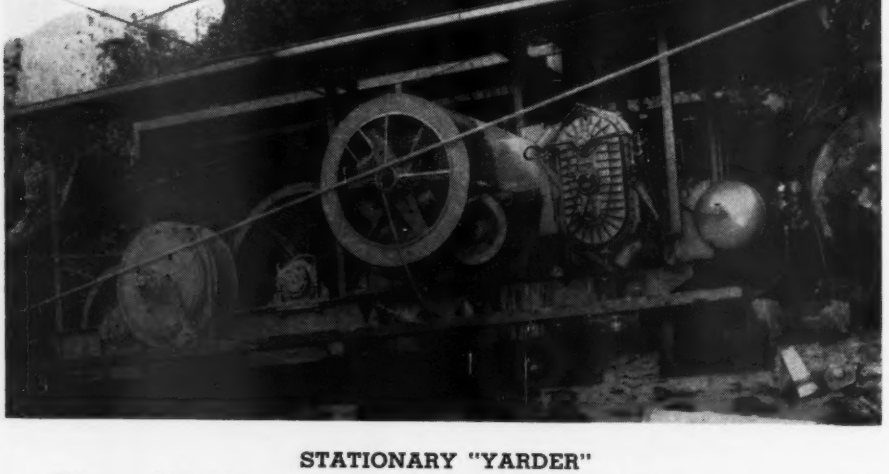
First, by interlocking the inhaul and outhaul drums so that they operate at the same speed. The trouble with this is that one drum empties as the other fills, which causes the inhaul- and outhaul-line speeds to vary rapidly when the drums rotate in unison. Thus, mechanical interlocking of the drums has not solved the problem. The second method of holding the load is with brakes on the outhaul drum. This requires "slipping" the brakes to keep the load in the air but still moving in. Brakes last only a few days, and replacing them is not only expensive but also time consuming.

Skagit's answer to the problem is the "Skyline" unit with a recently invented compensating differential interlock, an air-operated device that opens up a new era in logging.



MOBILE LOGGER

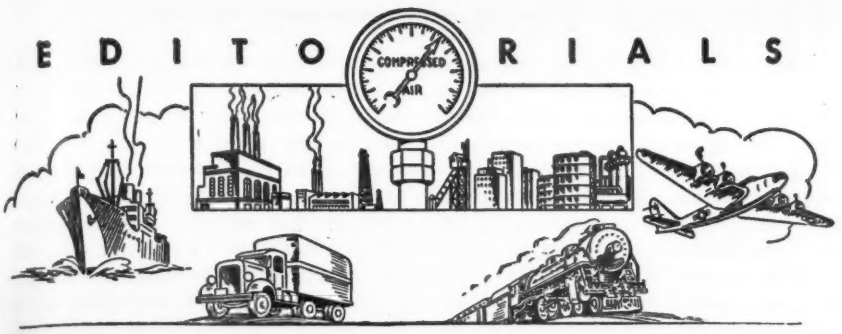
The SJ-4 Logger, the smallest of two new Skagit machines for maneuvering or loading logs, has air-powered friction-drive devices and brakes. To enable it to handle big logs it is stabilized by guy lines and hydraulic jacks.



STATIONARY "YARDER"

This powerful hoist, known as a Hylead and Skyline yarder, is set up at a convenient place in the woods during logging operations to haul out large timbers and to collect and stack them at a loading point. The view is of the side opposite the operator and shows (in center) the air-powered differential for interlocking the inhaul and outhaul cable drums to better control a log plunging down a steep slope or suspended while crossing a canyon in midair. The 4-speed drive mechanism is smoothly controlled by air, and the brakes and friction devices in the hoist drum set are pneumatically operated.

Since 1945 the production per man-shift at the Hollinger Consolidated Gold Mine, Porcupine, Canada, has increased 30 percent. Largely responsible are an increase in mechanization and a rather complete reorganization of mining methods, the latter having been instituted by E. L. Longmore, general manager, following the close of the last war when it became apparent that gold mines were in for a hard economic siege. Hollinger is 41 years old and has produced $430 million worth of gold. It is also a partner in the present extensive development of iron-ore fields in eastern Quebec and Labrador.



ROMANCE OF THE ROEBLINGS

AFTER operating independently for 112 years, the world-renowned firm founded by John A. Roebling is no longer on its own. Henceforth it will be a subsidiary of the Colorado Fuel & Iron Corporation, a much younger and lesser known concern, albeit a larger one. It is heartening to read that the new owners will keep the Roebling name. It would be a tragic consequence of industrial progress if it were to be abandoned.

The name of Roebling virtually exudes engineering romance. For seven decades schoolboys have been thrilled by reading of the exploits of the bridge-building family. The story of the creation of the Brooklyn Bridge in itself runs any novel a hard race for heart-pulsing drama and excitement. The Roeblings truly rank among the builders of America.

Every lad dreams at one time or another of constructing strong, graceful bridges. In his native German town of Muehlhausen, Johann Roebling had such dreams and he lived to see them fulfilled. In fact, he probably built even bigger spans than he conjured up in his juvenile mind, for he came to America where there were bigger rivers that needed bigger bridges to cross them.

The son of an unimaginative proprietor of a tobacco shop, young Roebling received an excellent education, topped off with a course in the famed Polytechnic Institute in Berlin. For three years after his graduation he served the Prussian government as a highway engineer. In his spare time he studied bridges, and when he heard that a "miracle" structure across the River Regnitz at Bamberg was held up by chains strung over towers, he went to see it and was much impressed.

He wanted to do original work, but there was little opportunity for that under the autocratic German rulers of the time. So, like many other freethinkers, Roebling came to America. After a storm-swept 11-week passage, he arrived in Philadelphia in 1831 and, by prearranged plan, settled with 300 other colonists at Saxonburg, Pa., 25 miles from Pittsburgh. Soon he was working for the state as an engineer, building locks and dams on canals and surveying a route over the Alleghenies that became a part of the Pennsylvania Railroad.

To surmount elevations, canal boats were hauled up inclined planes by hempen hawsers from 6 to 9 inches in circumference. Some were a mile long and cost up to $300, and the service was so severe that they did not last long. This caused young Roebling to think about wire rope which, he had heard, was being made in Germany.

Having assured himself that the State Board of Public Works would welcome such rope, he devised machinery for its production and set up a factory on the Saxonburg farm, utilizing the old ropewalk system by which fiber rope was traditionally manufactured. His cable was used on the Delaware & Hudson Canal and on the 22 planes of the Morris Canal that extended from the Delaware River at Phillipsburg, N. J., to Jersey City.

All the while, however, Roebling had bridges in the back of his mind, especially suspension bridges like the one he had seen at Bamberg. He had his first chance to try out his cables in this service in 1844-45 when he suspended a flume that carried a canal over the Allegheny River at Pittsburgh. He used ropes 7 inches in diameter, and they supported the flume and 2100 tons of water.

Then followed a vehicular bridge across the Monongahela at Pittsburgh, a structure that carried traffic, including 8-horse teams, electric cars and steam rollers, for 35 years. Its two 4½-inch cables were fabricated on a bank of the stream, towed out on flatboats and hoisted into place. Four more suspended aqueducts were next erected by him.

Wire rope made in Saxonburg had to be shipped by canal. That was too slow a method of transportation, so in 1848 Roebling moved his factory to Trenton, N. J., which had both water and rail facilities. Trenton's population was then only 6000, and the Roebling works soon became its largest industry. The introduction of elevators for buildings a few years later increased the demand for wire rope. In the firm's ensuing expansion a new plant was put up a few miles down the Delaware and the town of Roebling was established. The concern was incorporated as John A. Roebling's Sons Company on January 13, 1876.

Roebling vaulted into the limelight by bridging the Niagara River near the falls in 1855. The 2-deck, combination highway-and-railroad structure had a central span of 825 feet and was tested by running across it the heaviest train available. The 1057-foot Cincinnati-Covington bridge over the Ohio and another across the Allegheny at Pittsburgh brought him further acclaim.

All these efforts were only a dress rehearsal, however, for the big show—the building of Brooklyn Bridge. Roebling himself first suggested the daring project of spanning the East River as early as 1857. But the people were content with the ferry service, and nothing happened until a severe cold spell in the winter of 1866-67 choked the waterway with ice and stopped the boats from running. Clamor for a bridge followed, and it was authorized by the State Legislature.

Erection of the notable structure of unprecedented dimensions, with deep caissons for its tower foundations put down by aid of compressed air and with other outstanding features, required a period of fourteen years and took a heavy toll of the Roeblings. John A. was fatally injured almost at the outset and died on July 22, 1869. Fortunately, he left such explicit plans and directions that his capable son, Col. Washington Roebling, was able to carry on in his place without a break in progress. He, in turn, was a victim of overwork and of too much time spent in the caissons under air pressure and was a semi-invalid all his remaining years. The opening of the bridge on May 24, 1883, was an event of unrivaled public interest.

Roebling rope and Roebling brains contributed to three other great New York suspension bridges: the Williamsburg in 1903, the Manhattan in 1909 and, finally, the majestic 3000-foot George Washington over the Hudson in 1931. Farther up that river is the Bear Mountain span that was opened in 1924. Three generations of Roeblings had a part in their creation. All the structures are still in service.

Today, Roebling plants are among the nation's largest manufacturers of specialty wire, including music wire, upholsterer's spring wire and valve-spring wire. They still make quantities of wire for bridges, cranes, oil-well drilling rigs and numerous other industrial purposes; but in the imaginative minds of men Roebling still stands for suspension bridges.

And, before passing time can dim the luster of the name, it would be a fine and appropriate gesture if one of the famous structures the family created were to be christened Roebling Bridge. We can think of no better one to be chosen for this honor than the Brooklyn Bridge. The suggestion is respectfully presented to our leading engineering societies as a project worthy of their best efforts.

This and That

Likes To Be Cozy

The LeTourneau Company has been giving a lot of thought to making its Tournapull and Tournadozer earth-moving vehicles safe and comfortable for drivers. Electric controls take the heavy work out of shifting gears and steering, foam rubber seats and low-pressure pneumatic tires absorb most of the jolts and jars, and air-operated brakes make for easy and smooth stops. The company thought it had done right well by the men who pilot the big machines, but one of them showed them a new wrinkle. This winter, he came to work in an electrically heated flying suit, plugged it into a light switch in the cab and kept his body at a cozy 70° despite the freezing temperature outside.

★ ★ ★

Visualizes Record Gas Pipe Line

Bechtel Corporation, which probably builds more oil and gas pipe lines than any other concern, has proposed a natural-gas carrier extending from Iraq to Paris, a distance of 1800 miles. It would far exceed in length any line in the United States. Intermediate cities served would include Ankara, Istanbul and Trieste. Compressors in fifteen stations distributed along two parallel pipe lines would push through a billion cubic feet of gas daily. S. D. Bechtel, president of the firm, estimates the cost at $775 million and believes gas could be transmitted to Paris for 32 cents per 1000 cubic feet, with lower rates at intermediate points. The figures arrived at are below the current price of the equivalent heat value contained in coal, oil or manufactured gas in the communities that would be served. An alternate, longer line would originate in Saudi Arabia, cross northern Africa to Morocco and veer northward to Paris via Spain.

★ ★ ★

Pneumatic Cement Handling

About half the cement handled in Sweden is now transported in tanks from which it is unloaded by compressed air. Containers of this type were first built into ships for coastwise service and recently applied to trucks. To serve construction jobs, the vehicles are equipped with two or more vertical tanks having a total capacity of 5 to 14 tons. If a tank trailer is added, the load can be increased to 28 tons. Each truck also carries an air compressor of suitable size.

Upon arrival at the building site the cement is blown through piping into steel silos by air at a rate as high as a ton per minute. The silos are a part of the handling system and are available in several standard sizes. They are equipped for weigh-batching the cement, which is automatically transferred to the hoppers of concrete mixers wherever electricity is available. Aside from their convenience, the silos occupy less space than piles of bagged cement and can be located up to 130 feet away from the truck unloading station.

As there are no moving parts other than those in the compressor, the cement's abrasive effect is minimized. The expense of bagging and of providing and disposing of bags is eliminated, along with the litter of empty paper containers. One man, the truck driver, can take care

of the delivery, and the time saved in loading and unloading permits trucks to be on the road that much more. Also, no cement is lost in the transfer by escaping into the atmosphere. Known as the Interconsult System, the scheme was conceived by Helmuth Carlsen, a member of the technical staff of AB Skanska Cement, Sweden's foremost cement producer. It has been patented in several countries, including the United States. Installations have been made in France, Finland, Norway, Morocco and Siam.

★ ★ ★

Pistons Simulate Bombs

Investigators working under a Navy grant at Stanford University are using air-operated pistons to simulate the concussive action of atomic bombs so that they can study the probable effects of blasts on buildings. Their model test "building" is not a building at all, but a 4-foot-high stack of metal rectangles, which the scientists say is sufficient for their purpose. There are nine air pistons: four each mounted horizontally one above the other on opposing sides and one directed downward at the top.

In the experiments, an electric timer actuates all four pistons on the side where the bomb supposedly explodes. A split second later the top piston presses down on the roof. Then, in rapid succession, the pistons on the side away from the blast come into play from top to bottom. An exploding bomb would work in that manner, say the experts. By regulating the air pressure and varying the timing of the thrusts, they claim they can reproduce with reasonable accuracy the actions of blasts of differing intensities such as would be caused by an H-bomb, an A-bomb and an old-type blockbuster. All sorts of instruments and equipment are set up to measure and record the results.

The performance is reported to be remarkably consistent and can be duplicated again and again, as the model is indestructible. The apparatus was designed by Prof. Lydik S. Jacobsen, head of Stanford's mechanical engineering department, and by Dr. Robert S. Ayre, now at Johns Hopkins University.

★ ★ ★

Clearing Way for Salmon

Canada will spend half a million dollars to blast away an obstruction that prevents thousands of salmon from returning to their ancestral spawning waters. An earth-and-rock slide in the Babine River Canyon in northern British Columbia deposited 130,000 cubic yards of material in the stream bed during the summer of 1951 and few fish have been able to get past it. The Federal Bureau of Fisheries has let a contract for the work, which is already in progress so the way may be clear for this year's salmon run.

★ ★ ★

Eleven Hammers in Line

What may well be the longest row of forging hammers in industry is being set up at the Torrance, Calif., plant of the Douglas Aircraft Company by MacIsaac & Menke Company, a Los Angeles contractor. Eleven Chambersburg Cecostamps, weighing up to 180,000 pounds each and all operated by compressed air, will be arranged in a production line 181 feet long. Each hammer, with its anvil and base, will be seated on a concrete inertia block in a pit approximately 12 feet deep. Individual blocks will weigh up to 300,000 pounds and will rest on a network of 30-inch steel beams. Under all this will be a system of springs capable of absorbing impacts up to 187,000 pounds with a maximum depression of 5/16 inch and intended to lessen both noise and vibration. The hammers will form sheet-metal aircraft parts up to 60x96 inches in size.

Air Flotation Recovers Grease from Waste Liquids

SETTLING basins commonly used for the recovery of grease from liquid wastes in packing plants and the like may have served their purpose if a new method developed by Bulkley, Dunton Pulp Company, Inc., works as well as reports have it. There is nothing new in the principle upon which it is based, for it has been used successfully for years in separating metals from their ores. Called Colloidair, it is a flotation process, but instead of resorting to a reagent such as pine oil to bring the solids to the surface, it makes use of compressed air.

Credit for the system goes to Dr. Robert A. Baum who conceived the idea back in 1949 when he saw air flotation at work reclaiming fibers in a paper mill. By it, the air is "dissolved" in the liquid waste and causes myriads of air bubbles to rise to the surface when the pressure is released, the same as gas does in the case of carbonated beverages when the caps are removed from the bottles. These bubbles carry along with them tiny particles of grease, which are then easily skimmed off and salvaged. Just bubbling free air through the liquid won't do the work, it would only stir up the mass; compressed air is required to float the solids. The liquor can be discharged into sewers or waterways without fear of plugging them up or polluting them.

What this means can best be explained by citing the experience of a Los Angeles packing company which formerly used settling basins and recovered from 25 to 30 percent of grease from plant waste. The remaining liquid still carrying most of the solids was dumped into the city sewer system, with the result that the mains became clogged and the company had to have them cleaned twice a year at its expense. In addition to this saving, the plant now extracts as much as 90 percent of the grease, it is claimed, by the Colloidair method, and sells it at a nice profit to glycerine and soapmakers.

Roundhouse wastes containing tank-car washings, petroleum, asphalt and fish oil, and fluids carrying colloids such as glue can be similarly treated for safe disposal. And in the case of certain solids, acids and alkalies that dissolve in liquids but cannot be removed directly by compressed air in the manner described, a chemical is added to precipitate the material so that the bubbles can bring it to the surface. In Detroit, Mich., automobile manufacturers are said to be recovering nearly 99 percent of the emulsified oils from spent machine-tool cutting fluids by means of the new process. The waste oil is dumped on coal piles and pays dividends by increasing the heating value of the fuel.

Self-contained Starters for Jet Planes

TWO small gas turbines to start jet-plane engines have been developed by General Electric Company's Aircraft Gas Turbine Division and should prove invaluable in areas such as advance combat fields where ground power is not readily available. One is operated by hot gases generated by the burning of a solid propellant, the other by products of combustion from jet-engine fuel and compressed air.

In the first-named starter, the fuel is contained in a cartridge inserted in a breech and is ignited electrically by a fast-burning charge that looks something like an artillery shell. A safety feature prevents firing until the breech is locked in position, and a 2-chamber assembly can be used to allow for one false start. By this arrangement two cartridges are fired successively—there is no need of reloading between shots.

The air-fuel system is made up of a storage bottle for compressed air and of another for pressurized fuel, of a combustion chamber and of ignition and pressure-control devices, all in a compact package for mounting on the turbine. The air flask should be large enough to provide for two starts; but that is not necessary in the case of the fuel bottle which can be quickly refilled by the plane's fuel booster system. Both containers can be charged on the ground from a compressor or receiver and in flight from an engine-driven compressor. The mixture of air and fuel is burned at high pressure in the combustion chamber, producing hot gases that drive the turbine which, in turn, starts the engine through a clutch. With this unit, starting time and torque can be varied widely.

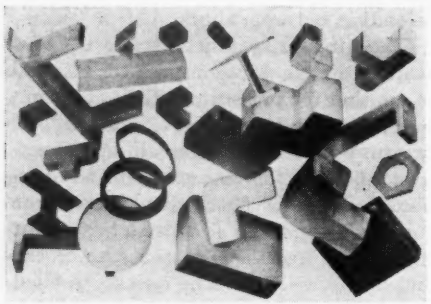
AiResearch Manufacturing Company also has a turbine starter that serves as a main engine accessory on jet planes and is now in production in a new $5,000,000 plant in Phoenix, Ariz. The unit is an outgrowth of the concern's refrigeration air turbines designed to cool cabins of military combat and commercial transport planes and, like them, is operated by compressed air which strikes the blades and whirls them around until they attain a speed of more than 85,000 rpm. Shaft power is taken from the turbine wheels through reduction gearing and delivered through the starter's output jaw directly to the engine, thus cranking it to firing speed and then assisting it up to idling speed. The unit weighs about 17½ pounds and is said to start an engine in less than fifteen seconds.

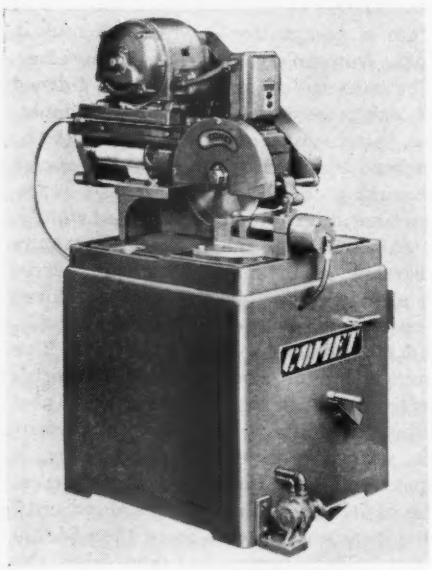
ROCK DRILLS PLAY "LEAD" IN WESTERN FILM

Rock drills are the inanimate but hardly silent "heroes" of the motion picture *Carson City* produced by Warner Bros. Pictures, Inc. The plot revolves around the construction of a railroad from Virginia City to Carson City, both in Nevada, at the height of the early-day mining excitement. A tunnel on the line is started by hand drillers, and progress is tedious until the arrival of a shipment of the then new "automatic" drills. When a landslide—caused by a group that is bucking the railroad project—closes a portal of the bore, Jeff Kincaid (Randolph Scott), the engineer in charge, is trapped inside with several members of his crew. The whole town turns out for the rescue job and, with the aid of the air-operated drills, a hole is punched through the rocky barrier just before the group inside is about to succumb from lack of oxygen.

Industrial Notes

For cutting nonferrous metals and other materials into bars, shapes and rounds, Consolidated Machinery & Supply Company, Ltd., has introduced a fully automatic precision cutoff saw for work up to 3½x6 inches in size. The Comet MH, as it is designated, is provided with a carbide-tipped 12-inch circular blade driven by a motor through V-belts, a pneumatic-hydraulic feed ram with a travel adjustable from 0 to 24 feet a minute, an air vise with a movable jaw, and a foot-control valve. Pressure on the pedal locks the vise in which the work is placed and actuates the ram. When a cut is completed, the saw returns to the starting point and the vise opens. Should the operator remove his foot from the valve while a cut is being made, the saw stops, its motion is reversed and the vise remains closed until the blade is clear of the work. The machine uses air at 80-100 psi pressure. It can be adapted for cutting with saws of different types, with abrasive wheels, and for friction cutting.





SAW AND PRODUCTS

The machine's pneumatic-hydraulic feed is co-ordinated with the speed of the blade and the vise is synchronized with the saw to close and open automatically at the beginning and end of a cut. The work done is smooth and burr free. The photograph from which the top cut was made was not retouched.

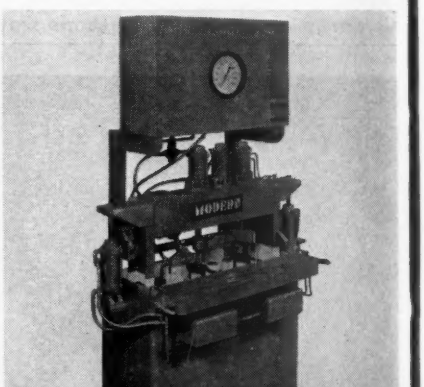
In place of the separate air-feed leg that serves as a mounting for a rock drill, Ingersoll-Rand Company has announced an integrated leg and drill—the JR-38 Jackdrill—which is said to be the first unit of its kind designed to meet all air-leg drilling needs. It can be used either as a drifter or a stoper

or, by loosening a nut, as a Jackhamer. The outstanding feature of the combination is a built-in coupling between the drill and the leg by means of which the air to operate the latter is passed through the drill, thus eliminating the third hose now required to shorten or extend the leg. All controls are built into the backhead, which is constructed so that flushing water is turned on when a 5-position throttle (blowing, off, feed, collaring and drilling) is opened. The throttle is in convenient reach of the operator, and when in the "off" position also shuts off the air supply to the leg so that it can be adjusted for removal to another drilling location without manipulating its air-pressure valve. The Jackdrill is available with 2-, 3- and 4-foot Jacklegs.

Variations in surface flatness can be exactly and quickly measured, it is claimed, by a new level that uses a beam of light as a straight-line reference and gives direct scale readings. The instrument has been announced by the F. T. Griswold Mfg. Company and is known as the Huet Optical Straightedge. It consists of an aluminum box-type housing of different lengths and of a feeder microscope with internal illumination guided by machined ways along the housing. A stylus may be attached to the microscope to draw a profile of the surface contours, enlarged 1000 times, on paper fastened to the side of the level. Accuracy plus or minus is said to be 0.00004 inch along a 3-foot segment.

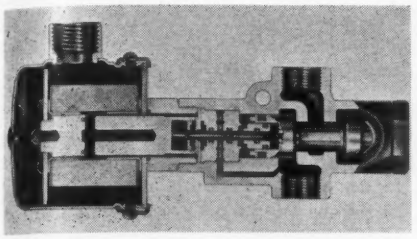
Made originally to see the oil level in Bijur automatic metered lubricating devices, window units of plastic set in corrosion-resistant metal frames are now available for installation in mechanical equipment as observation ports, lubrication check points, pressure or fluid-level indicators or protective instrument windows. The material is a product of the Cast Optics Corporation and is cast of optically clear allyl diglycol carbonate in sheets up to 60x60 inches and 78x96 inches in size and from 0.02 to 1 inch thick. The window units are designated as Cocor CR-39, and the plastic is said not to craze; to withstand abrasion, chemicals and heat; and to be unaffected by solvents, oils, acids, alkalies and hydrocarbons. It can be colored or mirrored, if desired.

To detect and spot leaks in cast-iron automotive-engine exhaust manifolds, Modern Industrial Engineering Company has designed a testing machine that performs both operations expeditiously with compressed air. The work is done by placing each casting in the unit and sealing its exhaust-gas areas in three planes with rubber-faced pads controlled by vertical pneumatic cylinders. When contact has been established, the test cycle starts automatically. The manifold is charged with a predetermined volume of compressed air which is trapped inside of it. Any loss in pressure in a preset test period is shown on a gauge and indicates that the part is faulty. To localize the leak or leaks, the casting is next immersed in a tank of water by lowering the head of the machine by means of two double-acting pneumatic cylinders, one on each side. This tank is illuminated from within and finished inside with a special paint to throw as much light as possible on the manifold so the operator can trace the porous places by air escaping from the casting and bubbling up through the water. The areas are then marked with chalk and impregnated with a suitable material to make them impervious.



To its line of fast-cycling 4-way solenoid valves, Crescent Valve Company has added a 3-way series for the control of light fluids such as air, water

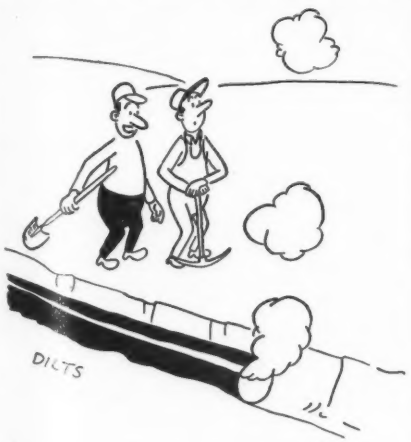
and oils. It is actuated by a pilot valve partially housed in the main valve piston for compactness and is designed for a pressure range from 20 to 500 psi for normally open or normally closed service. Minimum travel of moving parts



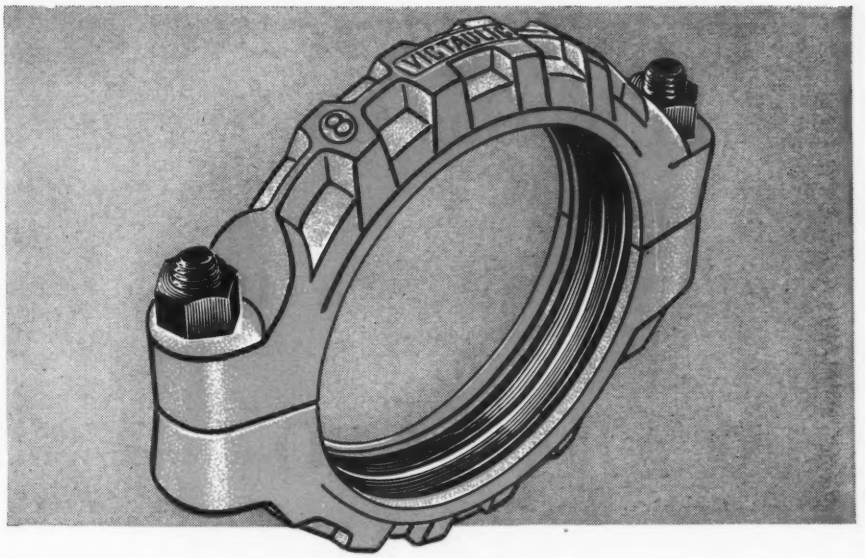
assures continuous operation at the rate of 600 cycles per minute for the smaller sizes. Valve body is of cast bronze, internal parts of brass and stainless steel, and molded synthetic-rubber valve rings provide tight seals. The Model 1034 is available with threaded pipe connections ranging from ¼ to ¾ inch.

Several new methods of grinding carbide tools have reached the testing stage, according to the Carboloy Department of General Electric Company, and promise to lessen our dependence on industrial diamonds—a critical item—from South Africa. Tungsten carbide now serves extensively for cutting and machining metals but, because of its extreme hardness, cannot be ground with the customary wheel materials and necessitates the use of diamonds. The new methods utilize electric power in one way or another to do the cutting, and while some of them still need diamonds, wear is so reduced, it is claimed, that the demand for the stones in this field of service would drop appreciably.

For use in offices, homes and for light industrial purposes, the Abbeon Supply Company has produced an attractive table-model humidifier that is simply plugged into an electric outlet. It vaporizes moisture through centrifugal force at the rate of more than one pint an



"It's a message from that Indian back in the Tulsa office."



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hour and holds a day's supply in its 16-inch-diameter container which, together with the dome, is 9 inches high. Both are made of heavy-gauge aluminum finished in green enamel. A unit of this size is large enough to take care of three average-size rooms. Humidistat control to turn it off and on is available.

Jean Gros, Inc., of Pittsburgh, Pa., makes huge balloons, usually in the form of animals, for parades and also stages processions in which its products are featured. They are mounted on collapsible steel trailers and pulled along. As many as 300 are kept in stock, and several Christmas parades with up to 50 balloons each can be held simultaneously in different cities. Some makers of balloons of this kind fill them with helium, and they must be held down with ropes to keep them from vanishing into the clouds. Gros inflates them with compressed air so they do not rise and perhaps become entangled in trolley wires or other overhead obstructions.

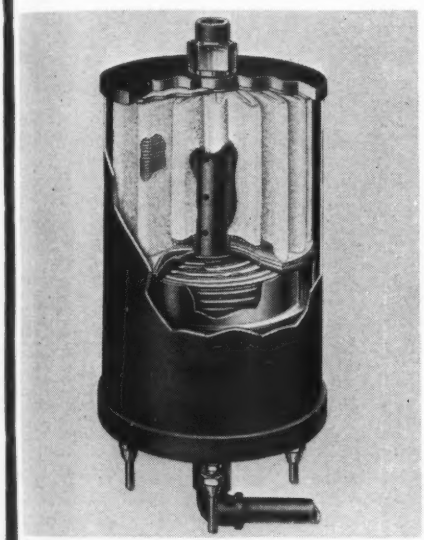
By aid of a quick-change tool holder, Barrett Equipment Company's new Air-Power Riveter can be utilized for stamping, punching, forming, riveting and deriveting operations in plastics and metal- and woodworking plants. The machine

is only 16 inches high over-all, has a throat clearance of 3½ inches and may be bolted to a bench or mounted on a base or stand. It is furnished with a foot valve, but may be controlled by

hand or automatically. Air at up to 125 psi is used, a shop-line pressure of 100 psi producing a working pressure of 1100 pounds with a $1\frac{1}{16}$-inch stroke.

A piece of coal 7 feet long, 2 feet wide and nearly 2 feet thick was recently displayed in Bournemouth, England. It was especially mined for the purpose of attracting attention at a meeting designed to educate people to conserve coal by burning it in efficient appliances.

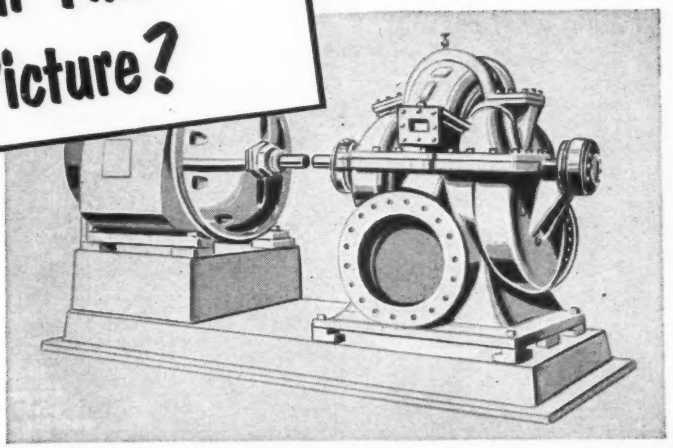
Hankison Corporation has announced an improved-model Condensifilter of the type designed to provide compressed air of "instrument quality" for a wide range of controls and services which necessitate the use of clean, dry air. It has a radial-fin filtering unit of wire mesh covered with flannel that offers 540 square



inches of filtering area. When spent, the cartridge is easily replaced. Air from a shop line enters at the bottom of the central shaft; is dehydrated as it passes through a water-cooled spiral condensing section; and dirt, oil and other contaminants are removed by the filter and discharged by a float-operated snap-action trap. The condenser has a surface area of 400 square inches and lowers the dew point of the air to within 2 or 3° of the cooling-water temperature. The Model B-30-D has a capacity of 30 cfm at 100 psig. Where greater output is needed, units can be installed in parallel; and where an uninterrupted flow must be maintained, a standby should be provided to permit servicing.

Heavy petroleum produced from a California field by Shell Oil Company contains about 50 percent sand. The two materials are separated by heating the mixture in coil-equipped sumps and by skimming off the oil. Disposal of the sand became a serious problem that was solved by mixing the oil-soaked residue with earth and using it to surface roads on which traffic is too light to justify paving with asphalt.

What's Missing In This Picture?



It is the one thing that will make these two pieces of equipment operate properly—a SHAFT COUPLING. Any shaft coupling will permit the motor to drive the pump. But the frequency of shutdown for repairs and the extent of damage to costly equipment depends entirely on the design, construction and quality of the coupling installed. To insure longer trouble-free operation, more and more buyers specify the

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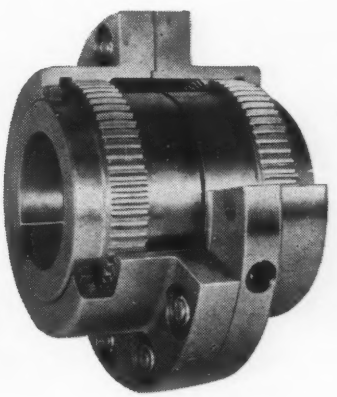

Their noteworthy design and operating features naturally appeal to men who understand transmission problems and requirements. All steel construction for maximum ruggedness; one piece cover sleeves; accurately crowned gear teeth; longer lining up surface; absence of all adverse crank action on shaft and bearing—these and other features combine to eliminate the usual causes for coupling failure.

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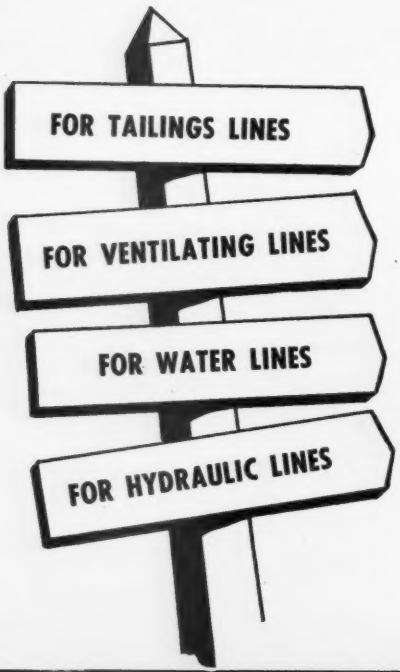

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Industrial Literature

A 16-page cataloguedescr ibing Hills-Mc Canna open- and closed-type force-feed lubricators for machinery of all kinds is now obtainable by addressing the company at 3025 North Western Avenue, Chicago 18, Ill. They come with 1 to 24 feeds per unit and in capacities from 2 to 32 pints.

A recent release by The Patent Scaffolding Company, Inc., deals with its new aluminum Fold-A-Way scaffold that can be carried, erected, rolled around and dismantled rapidly and easily. Copies of Bulletin ASF-1 may be obtained from the maker at 38-21 Twelfth Street, Long Island City 1, N. Y.

Catalogue CC-400 just released by The American Brass Company, Waterbury 20, Conn., contains full information on its seamless and strip-wound flexible metal hose and tubing. The 16-page bulletin also lists available sizes, alloys, and fittings, suggests applications and gives engineering data.

A 12-page manual offered design engineers by Simmonds Aerocessories, Inc., White Plains Road, Tarrytown, N. Y., covers the firm's precision push-pull control and fittings for aircraft and industrial applications. Included are construction features, types of installation, photos and drawings. Copies may be had upon request.

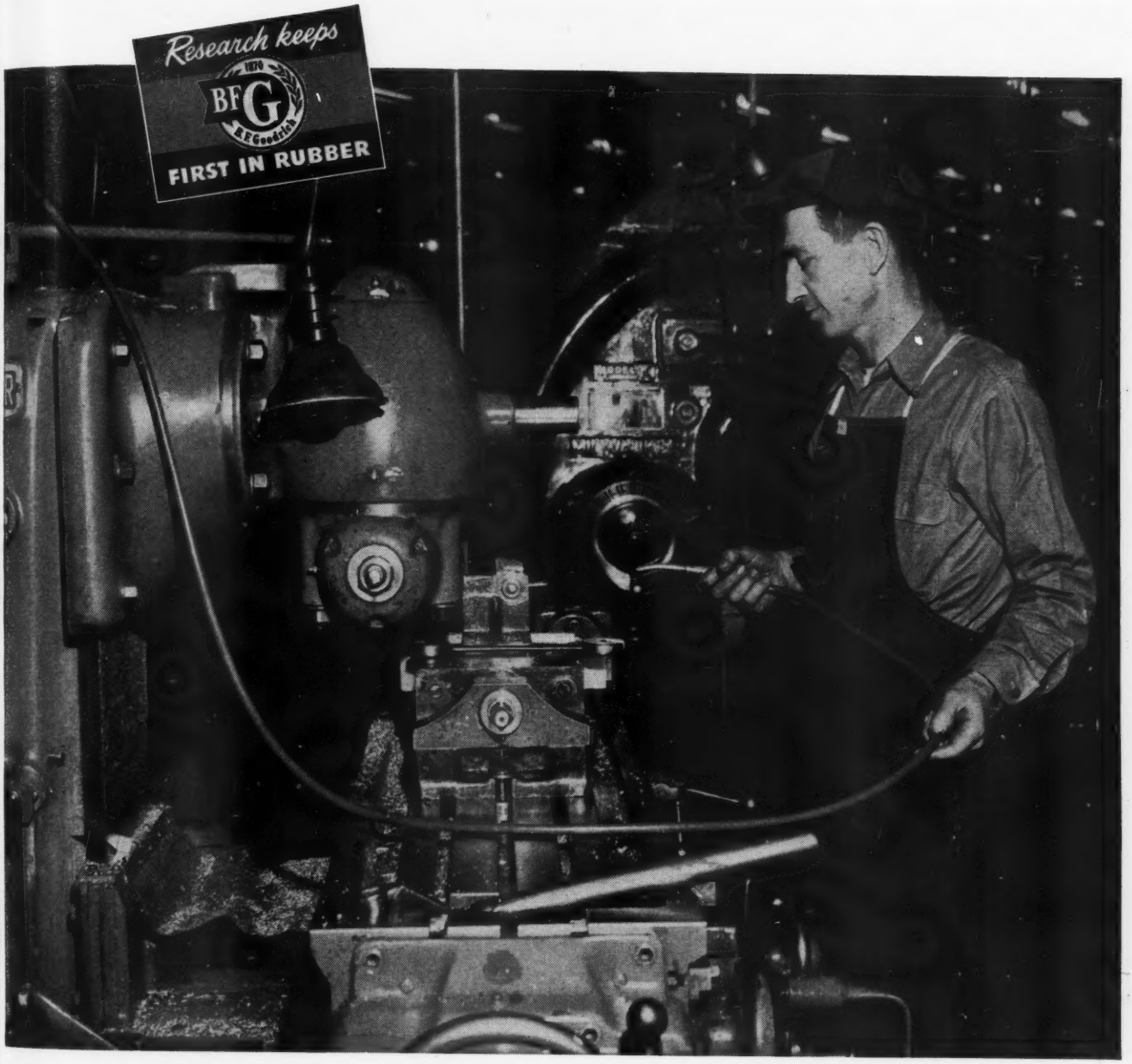
A 12-page illustrated bulletin, No. D-IL, is being distributed by the Dollinger Corporation, 11 Centre Park, Rochester 3, N. Y., on its line of liquid filters. In addition to descriptions of these units and of different types of filter media, it contains performance data and a list of filterable liquids.

In a recent release, U. S. Stoneware Company, Akron 9, Ohio, describes its Tygon paints and new "no-prep" vinyl primer Tygorust. Applications of the two corrosion-resistant coatings are included, as well as charts on primers and surface treatments and chemical-resistance characteristics. Address requests for copies of Bulletin No. 730 to G. W. Fine.

Fischer & Porter Company, Hatboro, Pa., is distributing a catalogue (C-50) which gives a detailed description of the action and components of its new Pneumatrol, a pneumatic controller for rate of flow, differential pressure, liquid level, viscosity, etc. The unit is a true motion balance controller and is suitable for single or dual instrument-case mounting.

Aluminum Company of America has announced the publication of a 24-page bulletin on its new heat-exchanger tubes that offer protection against corrosion both outside and inside. They are made of Alclad aluminum-alloy sheets butt welded longitudinally, and are available in 1-inch size (outside diameter) with a wall thickness of 0.049 or 0.065 inch. Copies of the bulletin may be obtained from the company at 801 Gulf Building, Pittsburgh 19, Pa.

The RLM Standards Institute, 326 W. Madison Street, Chicago 6, Ill., has announced the publication of the 1952 edition of the Reflector and Lighting Equipment Manufacturers Standard Specifications. The 46-page book contains detailed information on eighteen of the most commonly used incandescent and fluorescent lamps and includes revisions in existing specifications and two new specifications covering high-mounting reflectors. Copies are available free of charge to anyone concerned with industrial lighting.



Oilproof air hose 50% lighter, won't rot or clog; easier to work with

STIFF, heavy, hard-to-handle air hose wastes workers' time. Then too, there's a lot of oil around machine shops, air compressors, drilling equipment — almost everywhere air hose is used. Oil rots ordinary rubber. New B.F. Goodrich Highflex air hose has solved both of these air hose problems—

50% weight saving — Highflex is the first really lightweight air hose. 100 feet (¼" size) weighs 11.2 lbs. less than same amount of ordinary hose. Same proportion of weight saved on other sizes.

More flexible — Highflex is easier to work with. Workers can use it comfortably in close quarters, tight corners.

Oilproof cover, tube — Workers can use Highflex with oily hands or gloves, around oily, greasy surfaces. Air tools can now be lubricated without fear of oil causing tube to swell or rot into loose, gummy particles.

Higher working pressure — Making a new hose that's 50% lighter, more flexible and oilproof didn't cut down on the pressure it could handle. In fact, Highflex stands higher pressures than heavy, old type hose the same size.

B.F. Goodrich makes an air hose for every purpose, from small air tools to big construction machinery. If you use air pressure in your business, your local BFG distributor can give you the latest data on the improvements in B.F. Goodrich air hose . . . improvements that may save you money, increase production. Give him a call, or write *The B.F. Goodrich Company, Industrial and General Products Division, Akron, Ohio.*

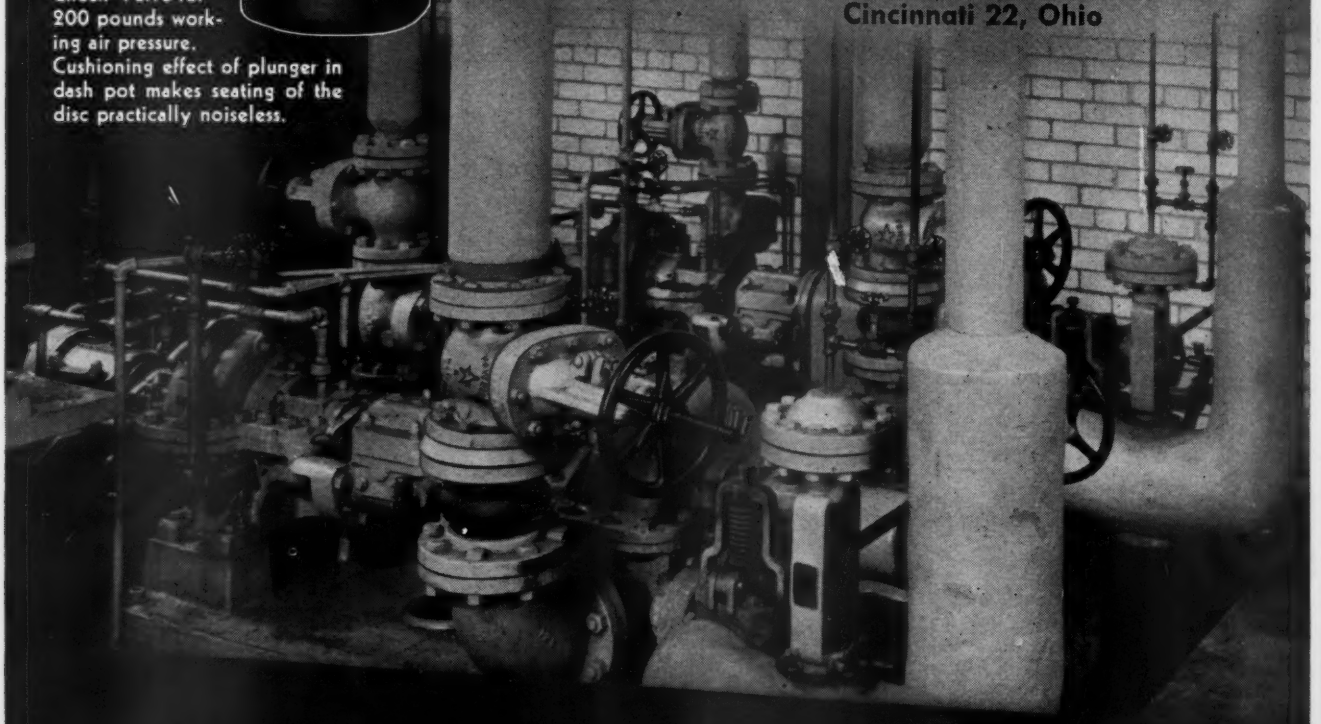
Air Hose
BY
B.F. Goodrich

POWELL gives you flow control at its best!

Fig. 95
Bronze Dash Pot Check Valve for 200 pounds working air pressure. Cushioning effect of plunger in dash pot makes seating of the disc practically noiseless.

Advanced engineering, laboratory control of all materials, expert workmanship and over a century of manufacturing experience make Powell Valves what they are today — flow control equipment at its best.

The Wm. Powell Company
Cincinnati 22, Ohio



POWELL

ELECTRIC MINE HOISTS ...by Canadian Ingersoll-Rand

Mine hoist installations require the closest cooperation between mine engineering staff and the engineers of the hoist manufacturer. For example, the hoist shown here had to be built in special sections to allow for transit underground through existing openings.

Canadian Ingersoll-Rand hoist engineering staff has the benefit of nearly seventy years of hoist manufacturing experience to draw upon — experience that has resulted in installations in practically every type of mining and in all parts of the world. This experience is at your disposal. Call an Ingersoll-Rand man when you want to talk about hoists.

CANADA

This 55,000 lb. rope-pull tandem-drum unit is installed underground at one of the mines of the International Nickel Company. The hoist is designed to raise men and materials four thousand feet at a speed of 1500 feet per minute. A similar unit is installed "on surface" at another of the Company's properties. Space limitations both underground and on the surface and fleet angle dictated tandem drum arrangement.

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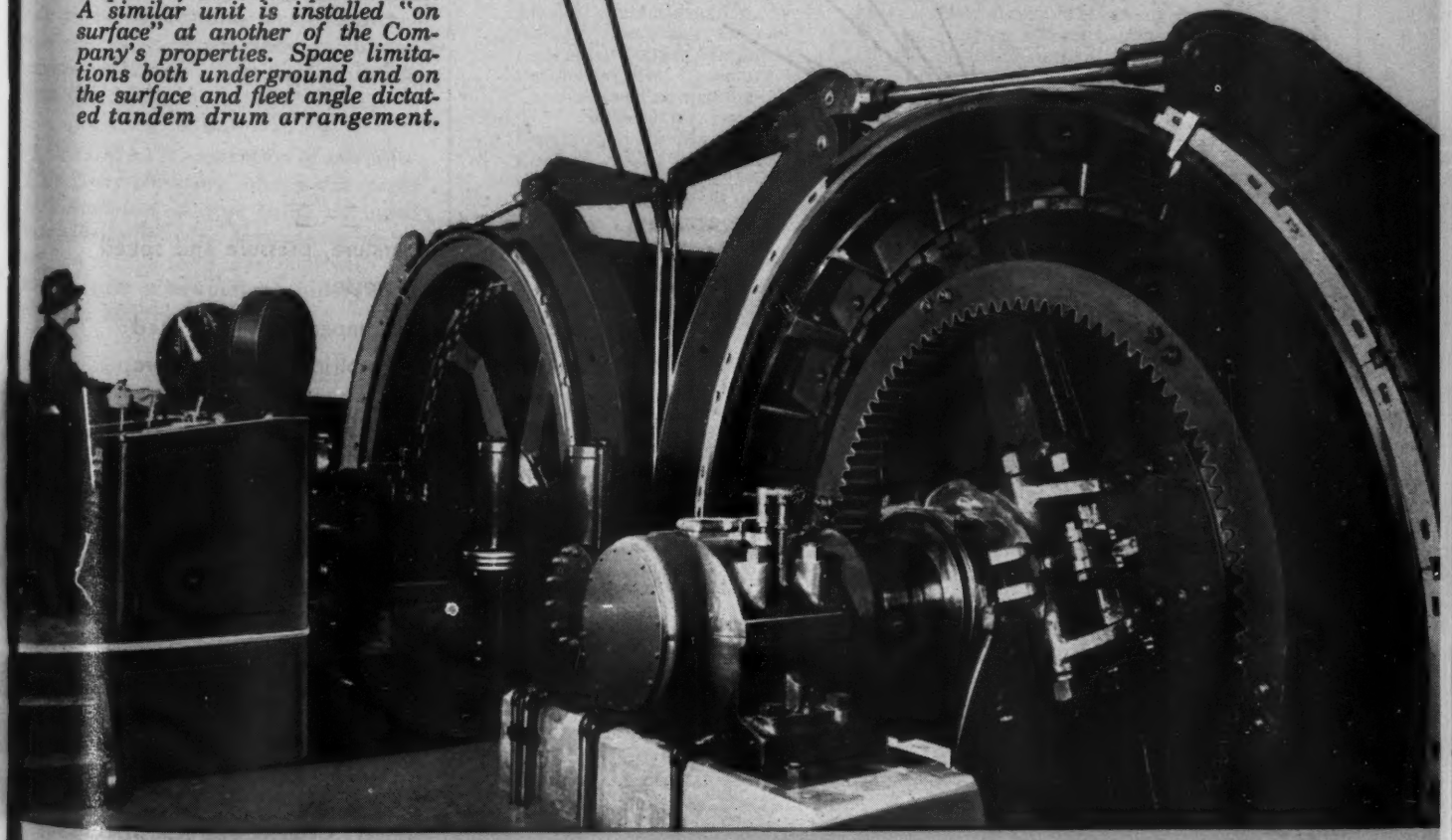

OVER SIXTY YEARS OF EXPERIENCE BUILT INTO EVERY HOIST

K-31

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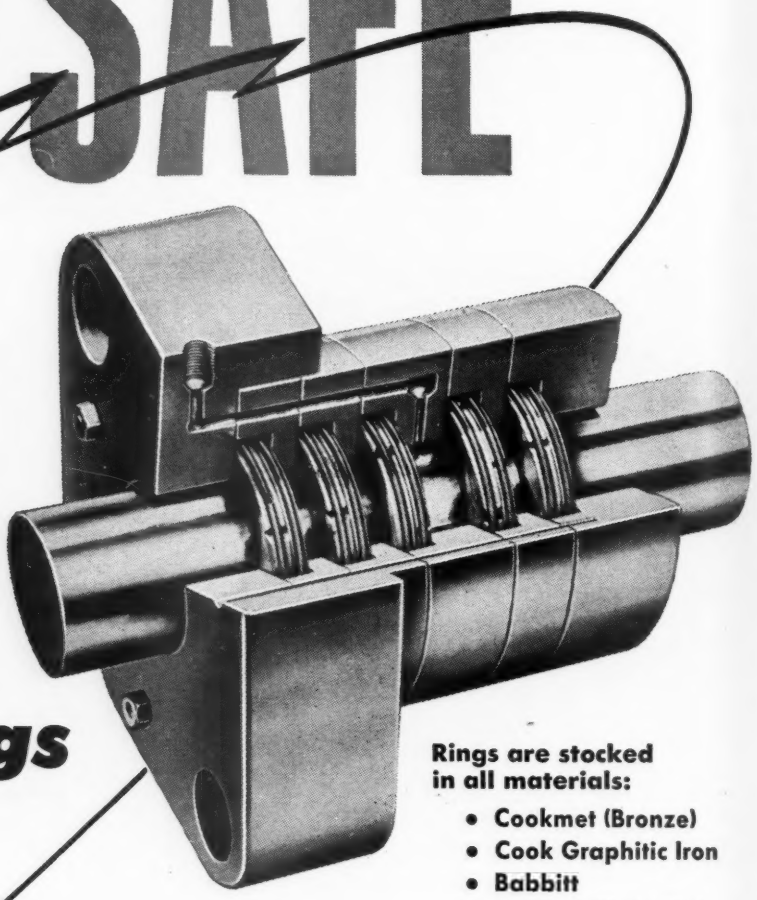
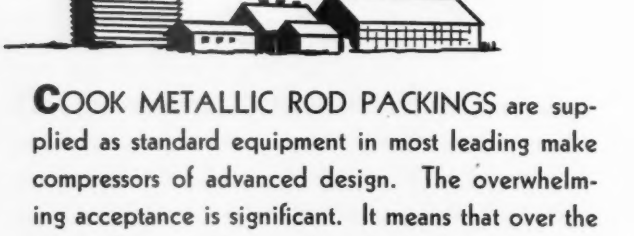
...insist on COOK Metallic Rod Packings



Rings are stocked in all materials:

- **Cookmet (Bronze)**
- **Cook Graphitic Iron**
- **Babbitt**
- **Cookroc (Bakelite)**



COOK METALLIC ROD PACKINGS are supplied as standard equipment in most leading make compressors of advanced design. The overwhelming acceptance is significant. It means that over the years these modern rod seals have consistently given efficient, trouble-free results in virtually every type of service. This record stands as your assurance of getting the best in packing performance if you specify Cook Metallic Packings when ordering new equipment. There's a proven style and size for almost every gas, temperature, pressure and speed and for every make compressor.

C. Lee Cook Mfg. Company, Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK

ROD PACKINGS

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